HOUSE PAINTING METHODS

With the Brush and Spray Gun

VANDERWALKER

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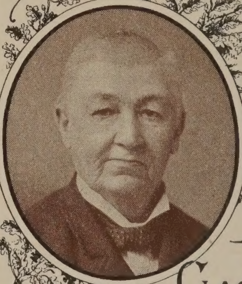

HOUSE PAINTING METHODS

WITH THE

BRUSH AND SPRAY GUN

INDUSTRIAL PAINTING ON STEEL, IRON, CEMENT, BRICK AND WOOD SURFACES

BY

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PREFACE

THE scope of this book has been confined to a consideration of methods, materials and tools essential to the painting of exterior surfaces of wood, metal, brick and cement.

An attempt to present the essentials of the whole trade of painting and interior decorating in one book is not an undertaking conceived in wisdom, the author believes. This is a trade which is indeed extensive as it touches upon craftsmanship, art, chemistry and science. A mere understanding of how many kinds of work are done is not enough, but rather a full knowledge of details is essential, to the end that the painter can go out and perform the work in an expert manner. Of course no book, or set of books, is sufficient in itself to assure such ability. Experience and practice at the work are necessary. Good books, however, speed the acquisition of knowledge and skill in any line of business, because good books are simply the record of the experiences and knowledge of those who have gone before and those who are active in the work today.

A brief examination of books which attempt to cover the whole trade between the two covers of a single volume discloses the omission of many important details. Many of the subjects have been merely outlined, others have been omitted entirely, leaving much to the student's imagination and taking for granted too much knowledge in the possession of the student.

Therefore, to avoid such omissions of important information the author's plan has been to cover the main

branches of the trade of painting and interior decorating in four books bearing the titles—

The Mixing Of Colors and Paints
Interior Wall Decoration
House Painting Methods
Wood Finishing, Plain and Decorative

It was the author's plan and ambition to record in these four books all of the necessary details about working methods of today, new and commonly used tools and modern materials likely to be needed by the painter who is doing any of the common tasks in his field in a first class and standard manner. Of what measure of success has attended these efforts you are the judge. If these books are found practical and useful in your everyday tasks of the trade they are accomplishing all that the author hoped for them.

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CHAPTER I

A SURVEY OF THE MARKET

MAN'S basic need is for shelter. Home buildings are essential, and in the United States alone, with its population of over 110,000,000 and 24,000,000 families, the fundamental stability of the building industry is well established, as it is in Europe and over the entire world.

In consequence the painting and decorating business as an important part of the building industry is in a very strong position in its relation to economic wealth. The market for the services of the painter and decorator is broad and permanent. It can be made even larger in proportion to the progress made in selling and general business ability by painters and decorators of today.

It is commonly estimated that out of the more than $11,000,000,000 worth of standing physical property in America not over twenty-five per cent is protected with paint. So, the seventy-five per cent of this huge sum represents a potential market of great size. And this doesn't include the normal increase of new buildings which occurs every year.

The four great markets for the services of painters and decorators are these: (1) residences, (2) factory

and other industrial buildings, warehouses etc., (3) retail stores and other mercantile property, and (4) public buildings.

It was calculated by the "Save the Surface Campaign" that the total amount of property in the United States needing the protection of paint and varnish, as nearly as could be estimated, is over $111,264,783,000. This enormous figure was divided as indicated in Plate 1.

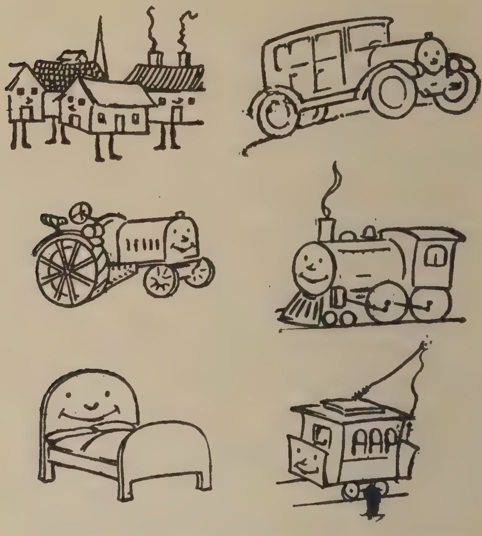


Plate 1.—Standing Property in the United States

This is a part of the physical property in the United States—it does not attempt to include nor is it possible to calculate, the value of all the property in this country which deserves the constant protection of paint and varnish.

A further analysis graphically illustrated in Plate 2 was made in this manner:

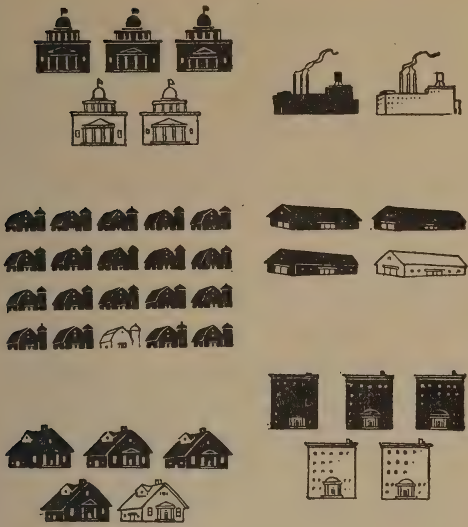


Plate 2.—Illustrating the Need for Painting

These pictures in Plate 2 tell the story of how badly paint and varnish is needed and how big is the opportunity for all of us.

Add the values together and we find that these various kinds of "standing property" are worth $84,000,000,000. Of this total amount only $21,000,000,000, or twenty-five per cent, is being properly protected by paint and varnish. That means there is $4.00 worth of business for you for every $1.00 worth you are now doing.

Not long ago a survey was made in an average American town just to see how much paint and varnish and its allied products were needed. The population of this town was 6,000. Here is what was actually needed by property in that town.

35,200	gallons of paint (all kinds)
6,600	gallons of varnish (all kinds)
5,000	gallons of enamel and bronze
$15,800	worth of putty, cleaners and supplies
55,000	hours of labor

Doesn't it begin to look as if there is plenty of room for all of us to grow? Of course there is, and will be, as long as the country is under painted.

These figures, of course, present a broad, national view of the market. In many localities there are times when there are painters without work to do. The property is there needing the protection paint affords but the painters have not developed their selling ability to the point where they are able to convince prospective customers that it pays to paint. That is a matter of education required by both painter and property owner and considerable progress is being made in both directions.

Purposes Served by Paint.—Without considering the use of paint in the industries for merchandise, paint, varnish, enamel, stains and other coatings serve four vitally important purposes:

(a) Preservation—Without the protection of paint wood decays and is destroyed by the elements just as certainly as by fire. Fire, indeed, is simply quick oxidation of wood, while decay is slow oxidation. That a building may be destroyed by fire is only a possibility; that it will be destroyed by decay is a certainty unless protected by paint on its exposed surface. Deterioration of most things starts on the surface—paint prevents the start.

Fire insurance doesn't cover this kind of loss, yet the annual loss by deterioration of building surfaces by decay is several times the loss by fire destruction.

(b) Decoration is the second most important purpose served by paint, varnish, enamel, stain, etc. The appeal of beauty and pleasing decoration is a much more

powerful force toward selling the services of painters and decorators to most people than are the hard facts and logical arguments based upon the need for preserving property from decay.

(c) Sanitary qualities of paint and other decorative coatings are convincing facts. Not only does painting have its own antiseptic value, but the cleaning which precedes painting also is a valuable factor.

(d) Better lighting is an important purpose served by using light colored paints and other coatings. Natural light is greatly increased thereby and also greater efficiency of artificial lighting is noted from the use of paint.

CHAPTER II

BRUSHES FOR PAINTERS AND DECORATORS

DESCRIPTION, USES AND CARE

Men who buy and work with these tools are not especially interested in their history, nor yet in the considerable detail of their manufacture. Yet there are certain detailed facts about brush materials and construction which contribute to a better understanding of the use and care of brushes. We will, therefore, first touch upon the outstanding facts concerning brush materials and construction.

Bristles for Brushes.—The most important part of a brush is the bristle which goes into its make-up. So far no material which is as good as hog bristle has been discovered or manufactured. A close examination of bristles shows that they are composed of a horny substance of an elastic nature possessing excellent wearing qualities. Bristles in former years came in greatest quantity from China and in best quality from Russia. Germany and France also supplied quite a large volume of bristle.

Originally Russian hog bristles were used exclusively in all of the large paint and calcimine brushes as well as in stippling brushes. The best bristles have come from animals reared in cold climates. The more nearly the animals approach the wild state the better the quality of bristles produced. The bristles of the Russian hogs, as a rule, are longer, thicker and have larger flag ends. Furthermore, the flag ends continue to form by splitting the bristle shank as the bristle wears

off. This is not true, to the same extent at least, of bristles coming from other countries.

A close study of hog bristle with a microscope shows that in reality the bristle is a hollow tube which tapers from a larger diameter at the root to a smaller diameter at the tip where it branches out into the flag ends. This flag end of each bristle is like a little brush in itself and that is responsible for the ability of a paint brush to pick up and carry a large amount of paint. See Plate 3.

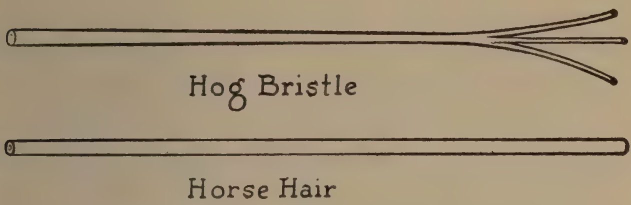


Plate 3.—Hog Bristles and Horse Hair

French bristles in the fine, white, soft grades have for many years been used for fine varnish and finishing brushes. In later years, however, Chinese bristle has been used and has given the best of results both as to working qualities and durability. Some believe the wearing quality of Chinese bristle is superior to French bristle as the brushes do not seem to get stubby so quickly.

The great bulk of bristle used in recent years is black and comes from China. Oval varnish brushes are made of practically all Chinese bristle and many believe that there has never been better stock for the uses to which this style of brush is put.

Chinese bristles make brushes which can be sold for a lower price than Russian bristle, although they do not wear as long. The long, tough Russian bristle resists

wear and abrasion successfully, but their greater cost would seem to offset this advantage.

Russian bristle ranges in length from 3½ to 7 inches; French bristle ranges in length from 2 to 4⅞ inches; Chinese bristle ranges in length from 2½ to 7 inches.

As to the color of bristle there is practically no preference. Color has little bearing, so it should not matter whether your brush is white, gray, yellow or black or mixed colors. The qualities of bristles which count in making of first class brushes are length, elasticity, solidity and uniformity. The Chinese bristle is black while the French bristle is white. Russian bristles are white, yellow or gray. Years ago gray bristle did not receive the care and attention in handling that white did. All brush makers now thoroughly sort, wash and give gray bristle a slight bleaching to insure cleanliness.

There are substitutes for hog bristle in the brush industry just as there are substitutes for the best raw materials in other industries. Manufacturers are led to a use of substitutes to some extent because some people buy on the basis of low price and because there is keen competition in the manufacture and sale of brushes. The principal substitute for hog bristle is horse hair taken from the manes and tails of horses. A great deal of horse hair comes from the state of Texas. The distinguishing feature between horse hair and hog bristles is that the horse hair does not contain the elasticity and life that we find in bristle. Horse hair does not have the flag or split end like the bristle.

Horse hair does not retain its stiff character when immersed in oil and, furthermore, not having the flag end it does not pick up and hold paint like hog bristle. It, nevertheless, has a place in good brushes when used by expert manufacturers who know its limitations.

Another material used in cheap brushes, as a substitute for hog bristle, or for mixture with bristle is known

as tampico. It is a grass fibre which grows in South America and Mexico. This fibre does not compare at all favorably in wearing quality with hog bristle. A brush made largely of tampico, which is a coarse fibre, will do rough work and show brush marks. Tampico is useful principally for whitewash brushes, dusters, floor brushes, etc.

Artists' brushes and those made for sign and show card writing are made from hog bristle, from black or red sable and from ox hair.

Materials other than high class hog bristles serve useful purposes in some brushes. For painting metal surfaces brushes may be better for having a proper percentage of horse hair in their make-up. It is true that horse hair makes brushes less elastic, but since the paint doesn't have to be worked into the surface as into the pores of the wood, at least not to the same extent, there is no objection to a certain amount of horse hair. In fact, it is an advantage, because it resists wear by abrasion better than hog bristle does. The life of the brush is thus increased.

Brush Construction.—Brush making today is in the hands of manufacturers who, for the most part, have spent a great many years in developing this art to its present state of scientific efficiency. You may depend upon it that the reputable manufacturers of standard advertised brands have developed brush design and construction to gain the utmost of desirable working qualities and durability from their tools.

A properly designed brush contains bristles of several lengths. Note illustration Plate 4. If the bristles were all of one length the brush would be "toppy"—it would flare out at the bristle ends. Many a brush is bought, because it looks full when, as a matter of fact, it is only a "toppy" one and may, in fact, contain too much horse hair. As soon as the flag ends of the bristle wear off the brush will leak, splatter and be so floppy as

to be unmanageable. A brush of good construction with several layers of bristles of different length retains its good working qualities for a long time. When the flag ends of the first layer of bristles wear out the flag ends of the second layer come into use, then the

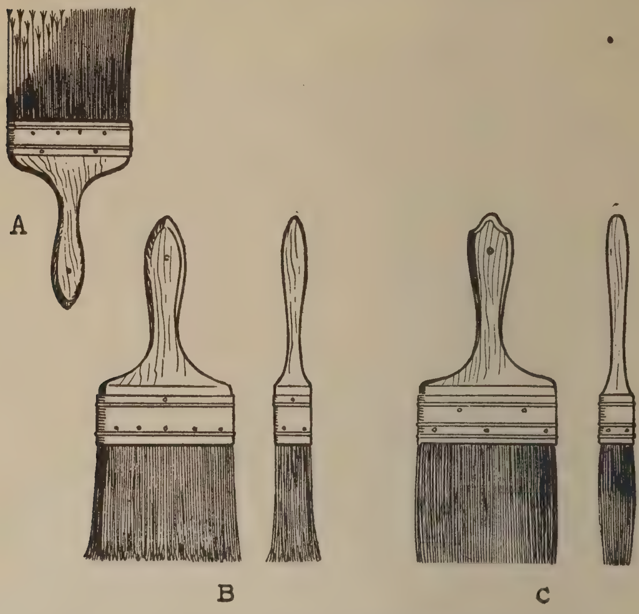


Plate 4.—(A) Showing the Distribution of Bristles
(B) How a Toppy Brush Flares Out
(C) Showing the Shape of Good Brushes

third layer, the fourth and so on. And all through the life of such a brush it will carry more material and lay off a smoother surface than a toppy brush or one having too much horse hair in it.

The use of bristles of several lengths not only has the above practical advantages, but it enables manufacturers to use short bristles as well as long ones. That decreases the price of good brushes.

The next important point for mention is the manner in which the bristles are secured, or bound together and to the handle. In past years we have used several methods for this purpose. There were cement-set and glue-set brushes. More recently we have the bristles vulcanized in rubber, we have bristles set in inert chemical cement and we have them compressed with metal ferrules and held in place by force.

There are various ways of mechanically setting the bristles within metal ferrules which are compressed by machinery into a permanent fastening of bristle ends. In some types the bristles are placed within the metal ferrules and swedged or forced into a permanent hold with plugs or wedges.

With most of the brushes on the market today it is no longer necessary to caution against the use of glue-set brushes in water, or of cement-set brushes in alcohol, or shellac. The modern brush factories use cements which are chemically inert and are not affected by oil, turpentine, alcohol, water or other solvent liquids in which they are commonly used.

There are other materials which enter into brush manufacture. (Note Plate 5 for the principal parts of a brush). Handles, ferrules, nails, paint, varnish, paper boxes, labels, rubber, shellac, glue, rosin and pitch, depending upon the kind of a brush and the purpose for which it is made.

WHAT MAKES A GOOD BRUSH?

What are the differences between good and poor brushes? One may go into a painter's supply store and see 4½-inch flat wall brushes which sell for about two dollars and the same size and type of brushes which sell for six dollars. Why the difference in price?

The higher priced brushes are made carefully and with the utmost of skill possessed by responsible, able manufacturers. They are made to possess the finest

working qualities and greatest durability. From that standard on down to medium good, fairly good, to cheap grades, the brushes are made as good as they can be made to sell for the prices which mechanics are willing to pay. It's the same old law of compensation working

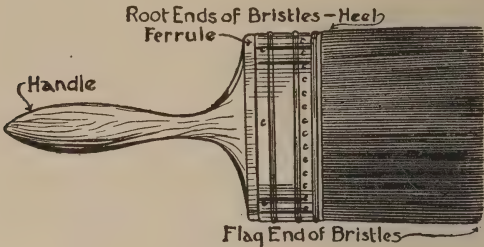


Plate 5.—The Principal Parts of a Brush

out here as it works out all through life; you get what you pay for. When you pay a lower price than is necessary to buy a brush with the utmost value in working qualities and durability, you get brushes of less value in proportion to the price paid.

A comparison of the best brush listed in a painter's supply catalog with the cheapest brush listed in the same catalog at the same time should be of interest. Take two 4-inch flat wall brushes.

The best brush listed in this size has black Chinese bristles 4¾ inches long. They are clean, straight as an arrow, bright and very springy. The design of the brush is excellent, well balanced, feels right and has a trim, handsome appearance. Russian gray or white bristle is not used in and is not needed for this type of brush. Few except calcimine and stippling brushes are made of Russian bristles, and the cost of these is so high as to give one pause.

The cheapest 4-inch flat wall brush listed in this same

catalog has black Chinese bristles only 3⅝ inches long and of a quality which is noticeably poorer, even to one not expert in bristle judgement. And while even this cheap brush, which sells for about one-fourth the price of the best brush listed, has a nice appearance, there are vast differences in working qualities, by which is meant that the best brush holds more material, doesn't leak and spatter as the cheaper one is apt to, cuts a clean, sharp edge along casings and trim work generally, is more springy and elastic and lays off a smoother coating of more uniform thickness than the cheaper brush. And, obviously, the more select, stronger bristles 4¾ inches long in the best brush will make that brush last longer in service than the poorer quality bristles 3⅝ inches long. In the better brush you have bristles 1⅛ inches longer.

There are necessarily other differences in quality of materials, in construction and workmanship between high class brushes and those made to fit a low price.

Cheaper brushes are made of bristles left over after the best grade and several next best grades have been selected for length, size, solidity, elasticity, flag ends, etc. Then the best bristles are given much attention to take the natural curl out of them permanently, to clean, dry, sort and assemble them into various lengths needed for each type of brush. In cheaper brushes the poorer bristles are apt to be used almost raw with only enough treatment to take out the curl temporarily. When the brush is used in liquids a while the bristles may go back to their natural curl;—a crooked, shapeless, twisted brush results, a tool which cannot be managed on first class work.

Cheaper brushes may contain too large a percentage of horse hair or even tampico instead of having hog bristles predominant. They are soft and floppy. You can't do good work with them.

In the matter of settings, good brushes may be set in

cement which is chemically inert and not affected by such solvents as alcohol and can be used to spread any of the materials commonly used in painting and decorating. Cheap brushes may have bristles set in poor cement or shellac, glue, pitch or rosin which will not hold them in place for a reasonable length of service; they will continually shed bristle.

Good brushes may have bristles set in metal ferrules so tightly compressed or wedged in place as to permanently prevent any shedding of bristles. Yet cheaper brushes may have nice appearing metal ferrules of improper design or which, because of poor workmanship, fail to hold the bristles permanently in place.

Bristles set in rubber would seem to solve all difficulties from shedding, yet that is not always true. Many high class brushes are set in rubber. If, however, the bristles are allowed to get too hot during the vulcanizing process they become brittle and break off,—the brush sheds bristle the same as any cheap brush. The rubber settings of many high grade brushes are now made with the rubber in solution and little heat. Except for the occasional carelessness of a workman rubber settings prove very satisfactory in service.

The final factor to consider is the matter of brush design. It is possible to make brushes of excellent materials and still be so faulty in design as to leak, spatter, wear into improper shape quickly and fail to do good work. Long experience and study have equipped most brush manufacturers with a knowledge of correct shapes and sizes necessary to produce successful brushes for each type of work.

How To Care For Brushes.—As important as it is to have and use high class brushes for first class work, it is equally important to learn and practise the proper care of them. Obviously, it is wasteful and expensive to neglect through indifference or ignorance the care of any brushes and especially good brushes. When to

clean brushes and how you do it are of considerable importance.

The time to clean brushes is immediately after using them, or within an hour or so of that time. If a brush is to be used again next day in the same paint it is best to put it into a pot of linseed oil over night. The oil should cover the bristles and come up on the ferrule an inch at least. The bristles should not touch the bottom of the pot. A hole should be drilled in the handle of every brush so that it may be suspended from a nail or wire hook to take the weight off the bristles. When the bristles touch the bottom of the pot or tub in which they are kept in an oil bath, they bend all out of shape. You will then have a crooked brush which cannot do good work; it will not cut a clean, sharp edge.

When it is not possible to suspend a brush in an oil bath to prevent the paint in it from getting hard, two other means are at hand. Wipe the paint out of the brush as much as possible on a board or with rags, then wash out the balance of the paint—all of it—in a pail of benzine, gasoline or kerosene. Lay the brush away flat on its side with all bristles straight to dry.

Brushes used in shellac and shellac substitutes may be suspended by a wire or holder in the pot of shellac, but it is much better to wash them out clean in alcohol as soon as you have completed the job, and every night. These materials dry so quickly that to fail to wash out the brushes soon after using them means a ruined brush, or at least a "seedy," "lousy" brush. The shellac becomes dry up in the root ends of the bristles, and while you can remove most of it with alcohol, little specks will always remain, making the brush unfit for any except rough work. See Plate 6.

Brushes used in varnish or enamel may be *suspended* in a bath of linseed oil or varnish over night or from job to job. Varnish brushes kept in an oil bath should be wiped free from oil before using in varnish again.

If this is not done the only other safe procedure is to wash them out clean with turpentine, lay them out flat with bristles straight to dry. Benzine or gasoline will clean varnish brushes only fairly well. They do not cut some varnishes at all. Turpentine is better.

Brushes used in aluminum or other bronze paints should be washed out clean immediately after using. Benzine, gasoline or alcohol should be used for washing.

Keeping Brushes for Long Periods.—In the shop the best way to keep brushes in first class condition is to

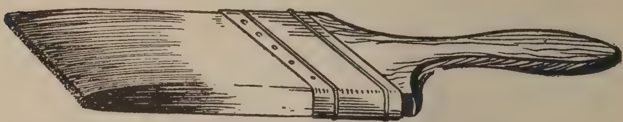


Plate 6.—What Happens to a Brush not Cleaned Soon Enough or Improperly. The Paint, Varnish or Shellac Brush Becomes Hard up Next to the Metal Ferrule Binding

suspend them in a bath of raw linseed oil. If a little turpentine is added and a little more oil from time to time the oil will not become fatty or rancid. The oil should be changed every few weeks. Varnish brushes may be kept in the oil bath, too, or in a bath of spar varnish.

Plate 7 illustrates good brush keepers. One metal lined with galvanized iron or zinc, the other a common wash tub or half of an oil barrel. The oil or varnish level should be kept high enough in the tub or trough completely to cover the bristles and about one inch of the metal ferrule or strap of the brushes. Otherwise the oil will dry a bit about the bristles where they enter the ferrule and a "seedy," "lousy" brush will result.

Perhaps the most important point about a brush keeper is that it must be so arranged as to keep the bristles at least two or three inches above the bottom of the tub or tank. Under no circumstances should the

brushes be stood on the bristle ends in the bath. Hog bristles are by nature curly or crooked. It takes long and expensive processes in the brush factories to make the bristles straight. A day or two will ruin the shape of the best of brushes when they are stood on bristle ends. Then the brush will not cut clean, sharp edges. It will be so out of shape as to be difficult to manage, and will not do good work;—it may leak and spatter excessively.

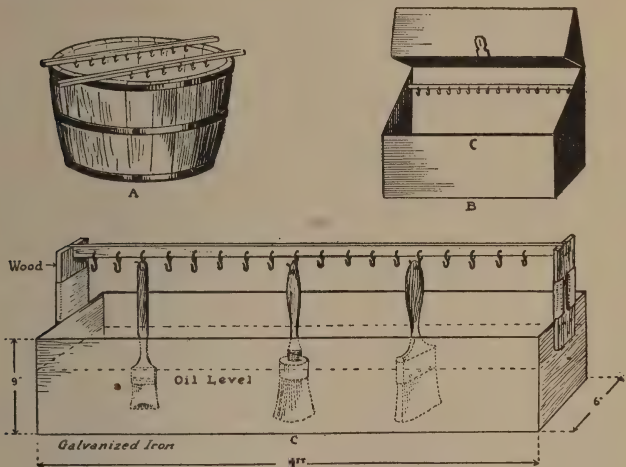


Plate 7.—Types of Brush Keepers in Use

The oil is a paint solvent. The paint left in brushes when placed in the bath gradually drops out of the bristles and settles in the bottom of the tank. This is another reason for keeping the bristles off the bottom of the tank. The tank must be cleaned occasionally to remove this paint accumulation. If the tank is constructed with a false bottom or loose pan, the cleaning can be done quickly and without removing the oil from the brush keeper tank.

Paint and varnish should be wiped and roughly washed out of brushes before hanging them in the oil bath. That keeps the oil clean longer.

Brushes used in aluminum or other bronze paints should not be suspended in an oil bath with paint and varnish brushes. It is quite impossible to wash bronzes out of brushes until washed and used several times. Some of the bronze can be shaken out when the brush is dry. If a bronze brush is put in the oil bath the small particles of bronze work their way into nearby brushes, causing rough paint and varnish coats later.

Water is the one liquid in which paint and varnish brushes should never be placed. You can find many painters and decorators who have the bad habit of keeping brushes over night and in the shop in a water bath, but it is a vicious habit just the same, and it ruins thousands of brushes for good work. An examination of hog bristles with a microscope shows one that each bristle is hollow like a rubber hose. When a brush is put into a water bath each bristle fills with water. The next time you put the brush into paint or varnish the holes in the bristle ends are sealed and the water remains indefinitely. Then you have a soft, flabby brush. The spring and life is gone out of the bristles and sometimes water will swell the wood handles of a brush enough to break the metal ferrule. Then the brush goes to pieces shortly. Also water is not a paint solvent. It allows the paint to dry hard in little specks up in the heel of the brush or roots of the bristles;—a "seedy," "lousy" brush results. The little specks drop out as you brush on the paint, varnish, enamel, etc., and a rough and dirty surface results. So *keep your brushes out of water.* It will pay in the longer life and better work of your tools.

Brushes which are not to be used for several weeks or months should be washed thoroughly in turpentine, benzine, or alcohol in the case of shellac tools. Be very certain *all* material is washed out of the bristles at the

heel—up next to the ferrule. Wrap each brush in paper held in place with string or a rubber band.

Then lay the brushes flat on a shelf with all bristles straight. Put some moth balls about the room. Moths lay eggs in bristles. Some painters make a thick lather of linseed oil soap and water and work this into the bristles and over the ferrule to keep them in good condition over winter.

The room where brushes are stored should be cool and even a little damp. Never store brushes on top shelves in a steam heated room.

Reclaiming Hard Brushes.—When a brush has been neglected to the extent of allowing the bristles to become cemented together with hard dry paint it is seldom possible to put the brush into first class condition to do good work. It can, however, be reclaimed for use on priming coats, roof painting and other rough work. It is easy to spend more time trying to reclaim a brush than it is worth.

There are on the market several prepared solvent materials which clean and soften hard brushes simply by soaking.

When there are several brushes to be reclaimed you can accomplish the work by soaking them in what is called Downie's formula:—

Submerge the entire brush in a metal tank filled with a solution made by thoroughly mixing:—

1 gal. denatured alcohol
1 gal. water white benzol 188 proof
1 gill muriatic acid

If a small quantity is to be mixed keep to the same proportions. Soak the brushes in this solution for 24 hours. Then remove each brush and scrape out the paint, using a putty knife or steel comb. Wash free from grit and small particles of paint by submerging the brush in a pot of benzine, gasoline or turpentine

and working the liquid through the bristles with your fingers. By this method all old and neglected brushes may be redeemed and they will be found useful for some purpose.

After cleaning the brushes in this manner they may be soaked with kerosene and laid flat on a shelf where they will remain soft. If the cleaning has been thoroughly accomplished the brushes may be stored and allowed to dry;—the bristles will remain soft.

Paint and varnish removers are successfully used for reclaiming hard brushes but as a rule they work more slowly than the above solution.

The Use of Brushes.—The first consideration about

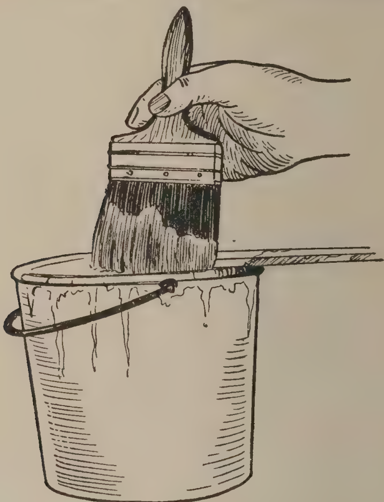


Plate 8.—Working the Brush into the Paint

using a new brush is to see that it is clean. Of course, it looks clean and the manufacturers have made an earnest effort to have the brush reach you in a clean condition. They have shaken out most of the loose bristles by machinery designed for that purpose, but

you may find a little dust and a few loose bristles in a brush. Hold the brush in one hand, carefully work your fingers through the bristles and shake the brush gently to jar out everything. Do not pound the ferrule of the brush on a board, as that will damage the handle and setting. Now wash the brush out in benzine and shake it dry.

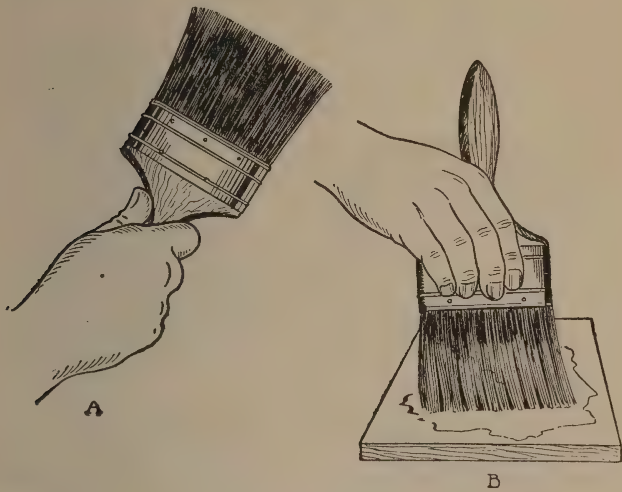


Plate 9.—(A) One Way to Hold a Brush for Large Flat Surfaces. Rather an awkward hold for some surfaces, but a good chance to rest the hand. (B) The Common and Correct Holding of a Brush.

When a new brush has been made clean, carefully work the paint into it by dipping the bristles into the paint only about an inch or two. Then wipe the paint off on the mixing paddle. Repeat this two or three times, as noted in Plate 8.

Holding the Brush.—The correct method of holding a brush is the natural method. Take an easy grip, being careful not to allow the fingers to extend too far down on the metal ferrule or the leather strap on stucco

brushes. See Plate 9. This is objectionable, not alone because the fingers become smeared with paint, but because fingers carried low on the ferrule exert uneven pressure on the center bristles. The brush is then worn into a fish tail shape as noted in Plate 10. Plate 9 also indicates another way to hold a brush to rest the muscles. There is no objection to holding this way for brief periods, but it is awkward except for large flat

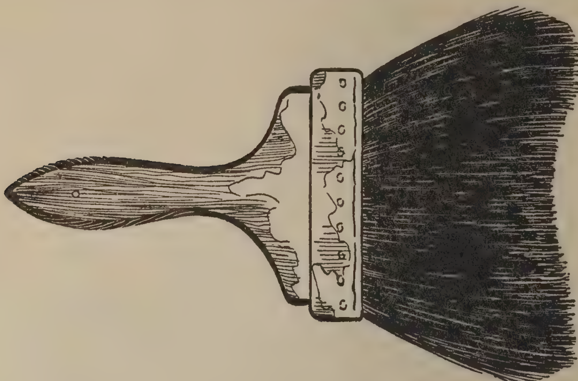


Plate 10.—A Brush Worn into a Fish Tail Shape. From exerting too much pressure in the center

surfaces; also it tends to make one use the brush at too great an angle, thus wearing the side bristles making a wedge shape brush, as per Plate 12.

An oval or round paint or varnish brush is held the same as a flat brush, but one must be very careful to avoid letting such a brush twist around in the hand at work. If that is permitted the bristles will wear all around the outer edge and to a point in the center as indicated by Plate 11. The brush is then useless for any except rough work; you cannot cut a clean edge with it. Many such brushes are chiseled on two sides by the manufacturers. They are, therefore, more quickly broken in to do nice finishing coats.

Spreading Paint.—Every paint brush has a certain limited capacity to carry a load of paint from the pot to a surface. The capacity depends upon the construction of the brush, upon the number and arrangement of the flag ends of hog bristles in layers,—some long and some short, as seen in Plate 4. There is,

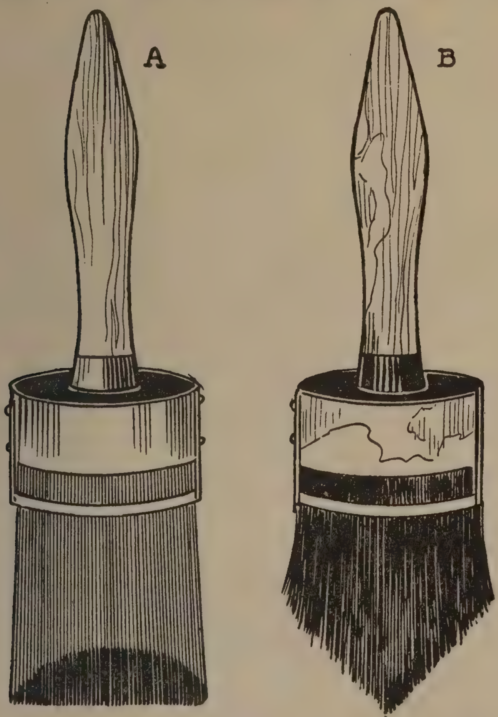


Plate 11.—(A) An Oval or Round Brush. Note bristles chiseled on two sides
(B) When the brush is allowed to turn around in the hand while working it is worn into a point and is then useless

therefore, no advantage and considerable disadvantage in dipping one's brush too deeply into paint. To dip

the brush into the material an inch or two, depending upon the size of the brush, is sufficient. When you overload brushes, the best of them will leak and spatter excessively. A good brush properly used will not leak and spatter.

It is the bristle ends, not the sides, which carry and smooth up the paint spread on a surface. Obviously, then, the more nearly a brush can be used at right angle to the surface the better. Of course, as you

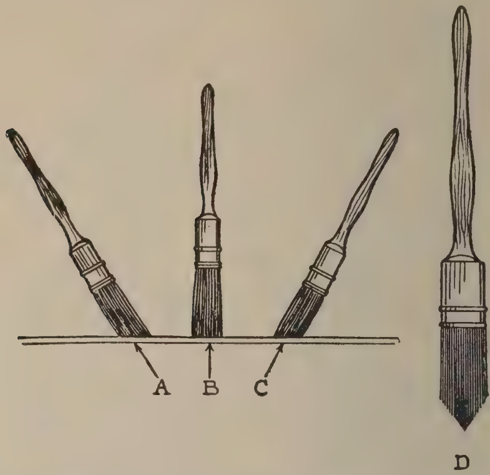


Plate 12.—(A) and (C) The brush used at too great an angle
(B) Keep the brush working as nearly at right angle to the surface as is practical, not inclined too much as in A and C
(D) Showing what happens to a brush used habitually at too great an angle

swing a brush from side to side it naturally will tilt first one way then the other, but don't let the angle become too acute, nor to assume a position which makes you lay off the paint with the side of the bristles, and wear the brush to a wedge shape by destroying the side bristles. Plate 12 is a diagram showing this point.

When learning to use a brush most effectively a me-

chanic should cultivate a free and easy swing, letting the wrist do most of the work. Don't "ride" the brush, but take an easy grip and exert an even pressure at all times to lay on a coat of paint of uniform thickness.

Spread the paint as far as one brushful covers well, brushing with, not across, the grain of the wood; then cross-brush the paint and lay it off by brushing again with the grain. Pick up the sags, runs, fat edges and run-overs on edges and corners; then let the painted area alone. Note that the up stroke on a side wall will lay on more paint than the down stroke, also that you can make a lighter finishing or laying-off stroke coming up than you can going down.

The bristles of a brush which is properly used will wear down evenly and the brush will retain a good shape for cutting sharp clean edges until the bristles become very short. As a matter of fact, the appearance and shape of a brush, after it has been in service for some time, is a good indication of the intelligence of the painter who used it. But what is most important is that brushes held and used in the correct way do the best work by spreading the material evenly and smoothly.

One of the bad habits developed by some mechanics is that of poking with the brush. That is very hard service and it soon bends the bristles so much out of shape that the tool will no longer cut sharp edges or do smooth and clean painting. See Plate 13. Poking turns the flag ends of the bristles and destroys the trim shape of the brush. On very rough surfaces like brick, concrete, rough plaster, ornamental iron work, wood lattice and grills where it is absolutely necessary to do some poking with the brush it is a good plan to use old brushes.

Another habit which ought to be avoided is that of using a large 4 or 4½-inch flat wall brush to trim narrow mouldings and edges. When a large brush is

used endwise instead of flatwise the corners of the brush

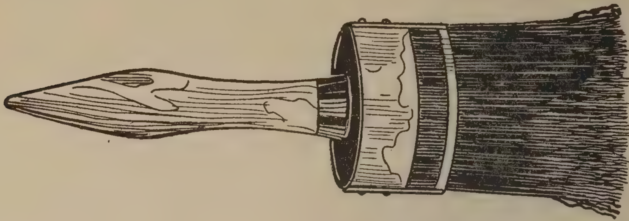


Plate 13.—A brush used in a poking manner soon gets out of shape. The bristles get crooked and the flag ends turned out of shape

are soon worn off as noted in Plate 14. The tool will not then enable you to paint sharp, clean edges. It takes about a minute to change to a flat or oval sash tool for painting such edges and there really is no excuse for damaging an expensive good brush in such a manner.

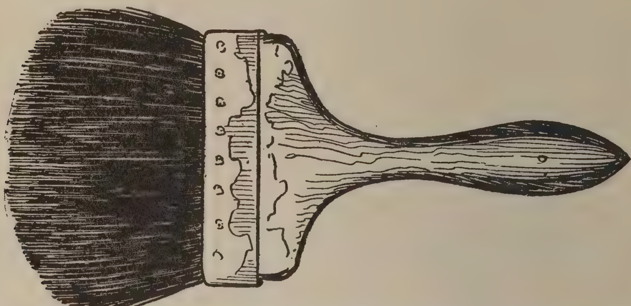


Plate 14.—A big brush which was improperly used endwise to do the work of a small brush on narrow mouldings

The use of a paint brush seems so obvious that it ought not to require any explanation, and yet many brushes are badly used. More are destroyed by improper use and care than are worn out in service. That makes a very considerable expense in the average paint shop for brushes every year. There is additional ex-

pense, also, when a mechanic tries to lay-off a nice finish with a poor brush, because more time is consumed in the attempt than if a first class, well shaped brush were at hand. To get the most out of any brush requires quite as much study and practice as the use of any mechanic's tool. Those who are young in experience, particularly, should practise laying the bristles of the brush on the surface in such a way as to draw them out to a sharp, clean edge, since that is the only way to spread paint in a clean and even manner alongside of mouldings, casing, etc. Note Plate 15.

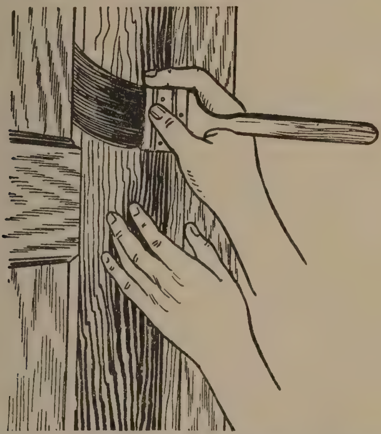


Plate 15.—Lay the brush on the surface to draw the bristles out to a sharp edge. Then a clean, straight line can be painted on sash, panels and trim

When a brush leaks while being used on ceilings or other overhead work, it is usually because the painter has overloaded it. Some brushes which are made with all or most of the bristles of the same length are "toppy." These look thick and full and to one without experience would seem to be excellent brushes. They do not carry as much paint as brushes made with bristles of various lengths. A toppy brush is apt to leak.

A brush which has been misused by allowing it to stand on the bristle ends in a pot of water or other liquid is likely to have its bristles so bent out of shape as to cause leaking and spattering.

Bridling Brushes.—There apparently is not as much need for bridling brushes today as formerly, at least the practice is not carried on to the same extent. The mechanics of the older school considered the ability of one to bridle a brush as a real test of his training as a painter just as they considered his ability to mix paints and colors to be such a test.

The purpose served by bridling is that of shortening the bristles of a new brush somewhat, before they are shortened naturally by wear, so that the brush will be stiffened and not spatter paint around. A brush which had been bridled was also thought to spread the paint more smoothly. A brush with extra long bristles which are a bit soft and too flexible, undoubtedly is benefited by bridling for a while.

The most common method of putting a bridle on a brush was to wind the brush with a rough, soft twine made of cotton, hemp or jute. The smooth, hard twine is not suitable because it slips off too easily. A fairly large twine was used on large brushes while a twine of smaller diameter was used on sash tools. The winding of the twine is indicated by Plate 16.

DESCRIPTION OF PAINTERS' BRUSHES

As to style and size of brushes, each painter has his own preferences. Some prefer the flat, metal-bound brushes while others are strong in their preference for leather-bound, flat stucco brushes. Some still prefer oval and round brushes for large surfaces. What brush is used most extensively depends somewhat, also, upon what section of the country you happen to be

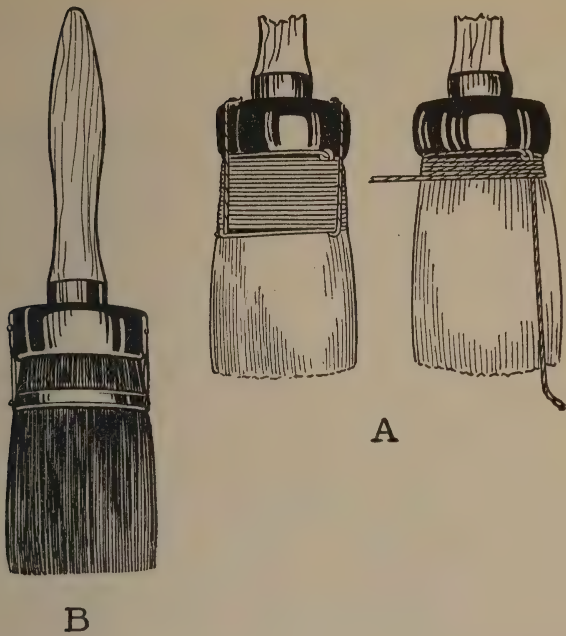


Plate 16.—(A) The method used to bridle brushes by binding with twine
(B) The metal bridle put on by brush manufacturers; in common use now

located in. In the following descriptions we shall simply describe each brush and mention the purposes for which it is commonly used by the average mechanic. Every painter should pay particular attention, however, to the various sizes of brushes needed for different classes of work. It is very easy to waste considerable time painting a large surface with a 3-inch brush when a 4 or 4½ inch brush should be used.

Flat Wall Brush, Plate 17.—In this illustration is shown a flat wall brush, with a beaver-tail handle, made of black Chinese bristle. This is a fairly stocky brush

which is made in half-inch sizes from 3 to 5 inches wide. The bristles vary in length from $3\frac{1}{2}$ to 5 inches, depending upon the size of the brush. A 4-inch flat wall brush having bristles $4\frac{1}{2}$ to $4\frac{3}{4}$ inches long is an

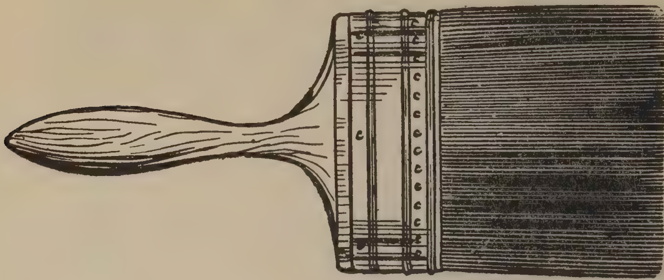


Plate 17.—A Flat Wall Brush

excellent tool. Such a brush is used for the application of all kinds of paint on interior and exterior wall surfaces. It is not used for varnish coatings.

Flat Wall Stucco Brush, Plate 18.—In some sections of the country leather-bound stucco brushes are used in preference to metal-bound flat wall brushes for the application of all kinds of paints, sizes and, in fact, most materials except varnish. These brushes are made, as a rule, from black Chinese bristle and with a rather thin pointed handle instead of a thick beaver tail handle. It is commonly thought that the thin handle is a bit more comfortable to use. The leather-bound stucco brush should contain more bristle stock than metal-bound brushes and it is made in sizes from 3 to 5 inches wide. Probably the best bristle length for a 4-inch brush is about $4\frac{3}{4}$ inches. The bristle should extend all the way through the leather binding in the best brushes. The cheaper grades of brushes of this type are plugged in the center of the handle at the root of the bristle. They are sometimes called solid-center

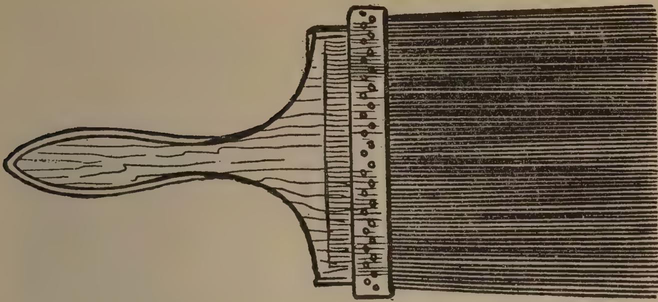


Plate 18.—Flat Wall Stucco Brush

brushes and are not considered by some to be as good as brushes made without the plug.

Flat Wall Brush, Metal-Bound, Plate 19.—Some

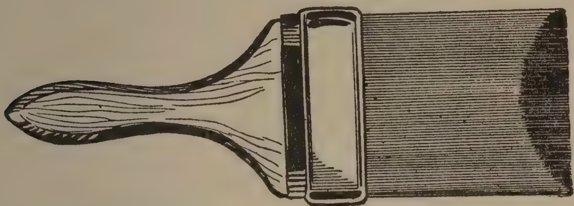


Plate 19.—Flat Wall Brush with Metal Wedged Binding

manufacturers are making a brush today which is designed to possess all of the virtues of the flat, metal ferrule type and the leather-bound stucco brush. In these brushes the bristles are firmly compressed and mechanically wedged into place to assure a firm setting, or they are set in cement which is inert and not soluble in any of the liquids commonly used by the painter. These brushes are made in the same widths—from 3 to 4½ inches, and the 4-inch brush of the best quality is made of bristles 4¾ inches long.

Oval Varnish and Paint Brush, Plate 20.—In former years the round and oval paint brush was much preferred for coating in large exterior wall areas. Today the flat wall brush is used more for large surfaces and

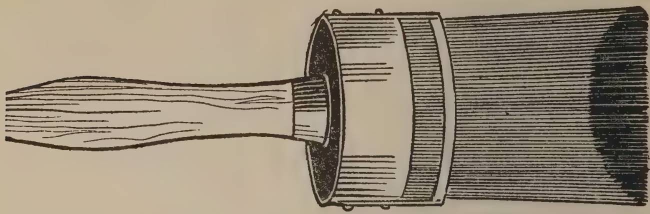


Plate 20.—Oval Varnish or Paint Brush

the oval brush is used for varnish and painting structural steel principally. The oval varnish brush today is much superior to the old style round or pound brush. It is, as a rule, made with the bristles chiseled on two sides and with that construction it does nice work immediately. With the old type of round brush it was necessary for a painter to patiently break in the brush, which consisted largely in using it in one position of the hand long enough to wear the bristles on two sides to a chiseled shape. With the old round brush, if the painter was not careful to prevent the brush from twisting around in his hand, the outside bristles on all sides were worn to a chiseled edge and then the pointed brush was quite useless for cutting clean, sharp edges.

The oval brush today is made both in solid and open-center types. The open-center brush is, as a rule, a better tool and has a greater working length of bristle. It is easier, also, to keep the open-center brushes clean, and they do not require a bridle to keep them in shape.

The oval brushes are made in several sizes from 1⅞ inches to 2¾ inches. The number 10 brush which is 2¾ inches wide is usually made with bristles 4¾ inches

long. It is an excellent tool for use on all manner of surfaces with either paint or varnish.

Flat Sash Brush, Plate 21.—These brushes are used

Plate 21.—Flat Sash Brush

for trimming window sash, doors and the trim, generally, on exterior and interior surfaces. They are quite similar to flat varnish brushes but have longer bristles. The bristle is the black Chinese product and the brush is made up with chiseled sides the same as varnish brushes. The flat sash is also thinner than the varnish brush. You cannot trace sash and small mouldings with a flat brush as thick as the varnish brush. These sash tools are made in several sizes. Those commonly used are 1 inch, 1½-inch and 2 inches wide. These sash brushes are made with bristles from 2 to 2½ inches long for best results.

Oval Sash Brush, Plate 22.—These brushes are used for the same purposes as the flat sash tools described

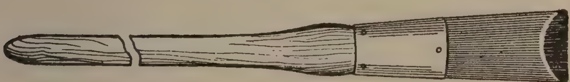


Plate 22.—Oval Sash Brush

above. They are made of black Chinese bristles in sizes from ⅞ inches to 1⅝ inches. The bristle lengths range from 1¾ inches to 2¾ inches. There is little choice to be made as between the flat and oval sash tools,—some prefer one and some the other. The flat sash brushes carry more material than the round and are to be pre-

ferred for mouldings and surfaces which are rather easy to reach. The oval brush on the other hand is better for window sash and fine mouldings.

Flat Varnish Brushes, Plate 23.—These tools look

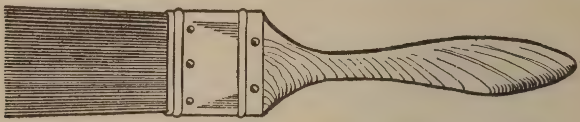


Plate 23.—Flat Varnish Brush

very much like flat sash tools, but the bristles, as a rule, are not so long. The varnish brush, however, is thicker, has more bristles so that it will carry more material. These varnish brushes are made in sizes from 1 to 4 inches. The bristle lengths range from 1¾ inches on the 1 inch wide brush to 3⅜ inches long on the brush having 4 inches width. These brushes are made with black Chinese bristle for most grades, but the highest quality flat varnish brushes are made with gray, white or yellow Russian bristle of greater length and more elasticity. These finer brushes are triple thick and are especially desirable for spreading enamel. Flat varnish brushes are made with chiseled sides and the handles may be round or blunt, tapered and rather sharp, or the

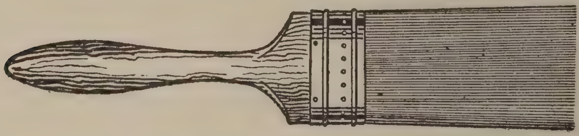


Plate 24.—Water Color or Cover Brush

round beaver tail type. The 1½-inch width of flat varnish brushes is popular for interior trim on mouldings and small surfaces, while the 3-inch width is mostly used for varnishing floors and other large areas.

Water Color or Cover Brushes, Plate 24.—It is very difficult to get a brush which works properly with water

color paints. The best brushes of this type are made of yellow and gray Russian bristles which are 4¼ to 4½ inches long on the brushes which are 3 inches wide. These brushes are often made up with yellow bristles on the outside and gray bristles in the center.

Flat Calcimine Brush, Plate 25.—These brushes are

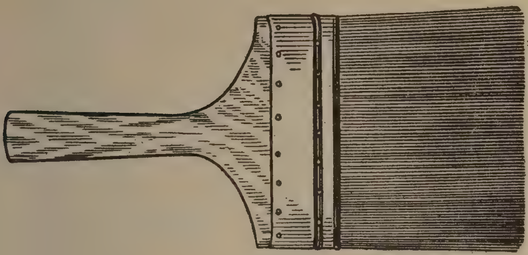


Plate 25.—Flat Calcimine Brush

expensive tools and, therefore, deserve exceptional care, not only to preserve them, but to keep them in first class working condition. The most expensive calcimine brushes are made of all gray Russian bristles which are extra long and stiff. The less expensive brushes are made of medium long black Chinese bristle. These brushes are made in widths of 6, 7 and 8 inches. The bristle of the 7-inch finest quality brush is usually about 5½ inches, while the bristles of the 8-inch width are 5¾ inches long. The medium grade of Chinese bristle brushes comes in bristle lengths of 5 inches and 5¼ inches for the brushes 7 and 8 inches wide respectively. The cheaper brushes have bristles from 3¼ to 4½ inches long. All calcimine brushes are made, as a rule, with settings which are not injured by use in any of the solvent liquids commonly used by painters and decorators, although they must not be used in hot lime or any substance like sal soda which will injure the bristles.

Dutch Calcimine Brush, Plate 26.—This type of calcimine brush is preferred by some painters because it will carry more material than the common flat type of brush. The best quality in this brush is made from Russian bristle of the yellow, white, gray or mixed

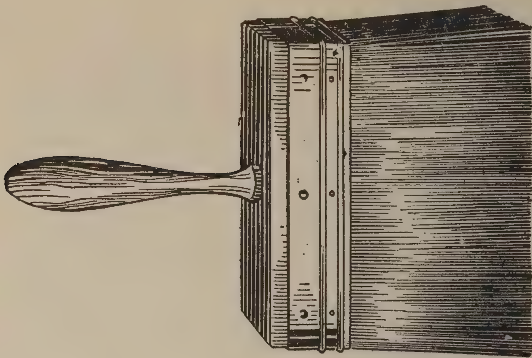


Plate 26.—Dutch Calcimine Brush

colors. Chinese bristle is not as good for these brushes. This brush is made in three sizes with different lengths of bristle for each size. The sizes are subject to a little variation depending upon the manufacturer who makes the brushes;—they may be 2⅜ inches wide by 7¼ inches long, or 2⅝ inches wide by 7¾ inches long, or 3¾ inches wide by 7¾ inches long. The bristle lengths vary from 4½ to 5 inches and you can take the manufacturer's judgment for the proper length of bristle for each size brush.

Whitewash Brush, Plate 27.—For factory walls and other large interior, or exterior surfaces, a brush is sometimes used on a long pole handle for the application of cold water paint or whitewash. These brushes are usually about 8 or 9 inches wide and with bristles 4 or 5 inches in length. The better quality brushes are made of Russian bristle which is gray, yellow, white or

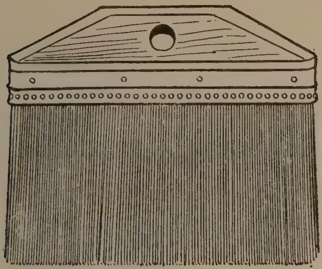


Plate 27.—Whitewash Brush

mixed in color. Some of the brushes are made with a leather binding, while others have a metal binding.

Round Duster Brush, Plate 28.—Painters' dusters are made to remove dust accumulations and the refuse from sandpapering surfaces to be painted. The better grades are made of Russian bristle in gray, white, yellow or mixed colors. The bristles, as a rule, are set in

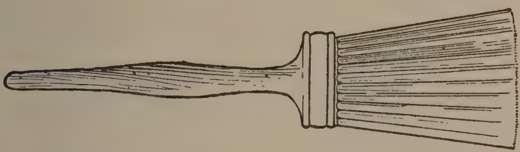


Plate 28.—Round Duster Brush

knots or groups and are securely fastened in the handle, sometimes by the rubber, sometimes with cement, or the mechanical wedging means. The bristle of all except the highest grade is black Chinese and may serve the purpose for which this brush is intended quite as well as the expensive brush. The bristles of dusters should be long. For the round duster $2\frac{5}{8}$ inches in diameter the bristles should be from 4 to $4\frac{1}{2}$ inches long.

Flat Duster Brush, Plate 29.—These brushes are sim-

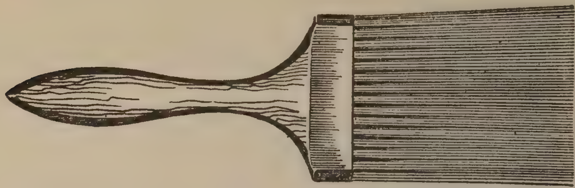


Plate 29.—Flat Duster Brush

ilar to the round type in all respects except that the handle is flat instead of round. Some of these duster brushes of both the round and flat types are set in cement which should not be put into water, gasoline or turpentine. The best types of dusters are made with settings which will permit washing the brush in any of these liquids. The less expensive duster brushes are made of the mixture of Chinese bristle, horse hair and tampico fibre. They are practical and serve the purpose well. The flat brushes are made 4 inches wide with bristles from 3⅞ inches long to 4¾ inches long.

Wall Stippling Brush, Plate 30.—These brushes are

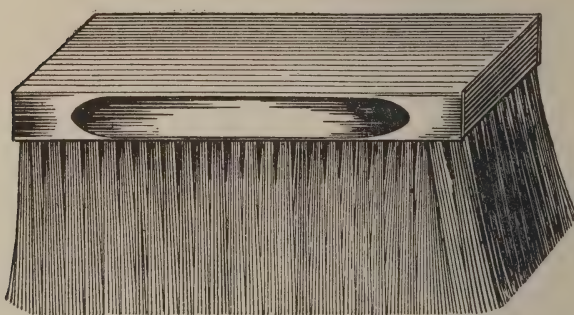


Plate 30.—Wall Stippling Brush

quite similar to the Dutch calcimine brush, but are without a handle. They are used only for stippling paint on interior walls and ceilings. Because of the fine construction necessary these brushes are expensive. They are used to give a texture to smooth painted plaster walls and to remove the brush marks from such painted surfaces. The brush is used like a hammer to pound the wet paint rather than from side to side to spread or smooth the paint like ordinary brushes are used.

Stippling brushes are made in different sizes. Those listed by one manufacturer measure 3 inches wide and 7½ inches long and, also, of larger sizes which are 3¾ inches wide and 9 inches long. The length of bristles varies from 3½ to 4 inches, and as to quality, the bristles are usually of the best grade of Russian quality mixed as to color.

Flat Artists' Brushes, Plate 31.—These brushes are

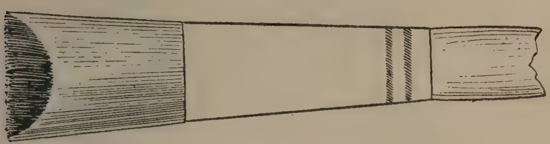


Plate 31.—Flat Artists' Brush

not much used by the painter, although occasionally one is needed for lining sash bars inside with a different color than is used on the rails and sash in general. Many types of these brushes are made in sizes from ⅛ inch wide to 1½ inches. The bristles are usually black Chinese stock from ⅝ of an inch long in the small brush to 1¾ inches in the brush which is 1 inch wide. Such brushes are made both flat and round.

Fresco Angle Liners, Plate 32.—These brushes are similar to the above artist brushes, but are made only in the flat type from ¼ inch wide to 1½ inches wide with

Chinese black bristles from 1 inch to 2¼ inches long.

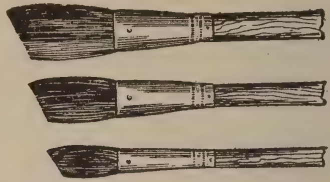


Plate 32.—Fresco Angle Liners

The bristles are cut off at an angle, as indicated by the illustration, so as to facilitate drawing straight lines with these brushes.

Flat Roof Painting Brushes, Plate 33.—For the paint-

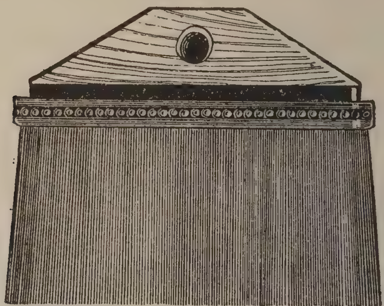


Plate 33.—Flat Roof Painting Brush

ing of metal and shingle roofs a brush with a long pole handle is used. These are very similar to whitewash brushes. They are made of Russian bristle and are leather-bound in the better grades. The brush is made from 7 to 9 inches wide. The 7 inch width with bristles about 3½ inches long is a convenient size for the average work. The brush is used like a sweeping brush and enables the painter to work in a standing position.

Round Roof Painting Brush, Plate 34.—This is another type of brush used for painting galvanized iron, tin and shingled roofs, using a long pole handle. These

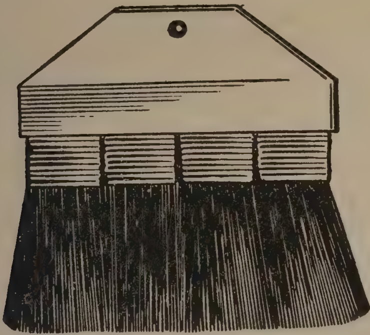


Plate 34.—Round Roof Painting Brush

are less expensive brushes made of black China bristle, or mixtures of bristles, horse hair and tampico fibre. The bristles are gathered in knots bound with wire and securely fastened in a wood block. They are made in sizes described 2, 3 and 4 knot width. The bristles are about 3½ inches long.

Floor Waxing Brushes, Plate 35.—Several types of

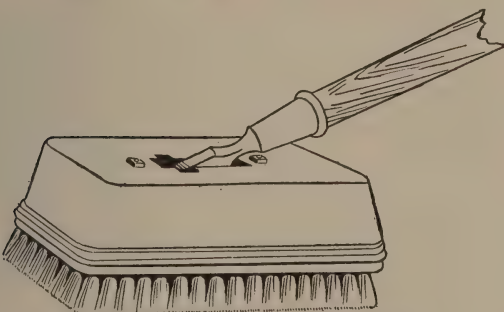


Plate 35.—Floor Waxing Brush

weighted brushes are made for polishing waxed floors. The bristles are very short—in the neighborhood of 1 inch long, and are made of mixed bristle or tampico fibre. The bristles are gathered in knots and fastened with wire into a solid block or bound with various settings preferred by different manufacturers. These brushes are weighted with a cast iron block, and the brush weighs from 14 or 15 lbs. to 23, 25 or 40 lbs.

Brick Liners, Plate 36.—Painters are often called

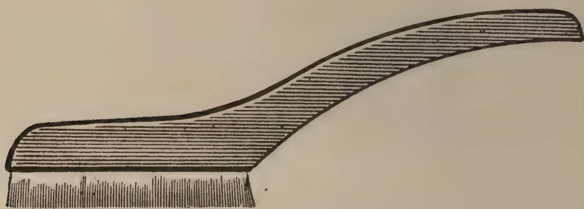


Plate 36.—Brick Liner Brush

upon to paint common brick and to line the mortar joints with black or other color. This is a rather tedious job unless a special lining brush is at hand to do the marking. These brushes are made with short bristles and they come in widths of 2 inches, 2½ inches or 3 inches.

Stencil Brushes, Plate 37.—For use in transferring

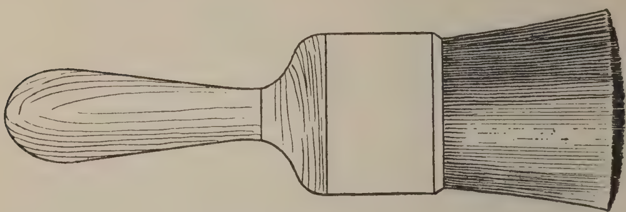


Plate 37.—Stencil Brush

paper or metal stencils on interior decorating jobs and for letter or numeral stencils on exterior work, special short bristle brushes are most convenient. These brushes are round, made of short bristles and bound with metal, as a rule. They are made in several sizes 5/8 of an inch in diameter to 1 3/4 inches. Both black and gray bristles are used.

Fresco Stencil Brushes, Plate 38.—This is a rather long-handled round brush used for transferring stencils in water colors or distemper. It is made with longer

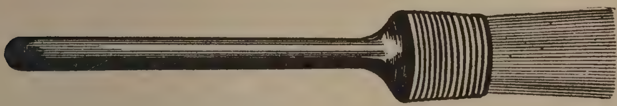


Plate 38.—Fresco Stencil Brush

bristles than the ordinary stencil brush. The common size is 1 1/2 inches in diameter with the bristles 2 1/4 inches long.

Soft Flowing Brushes, Plate 39.—This brush is used

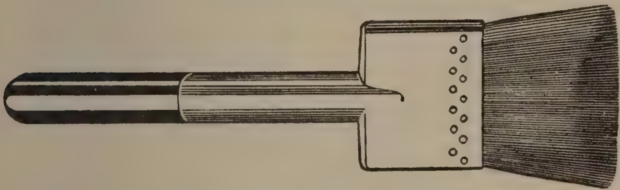


Plate 39.—Soft Flowing Brush

largely for flowing fine enamel coats. It is made of ox hair set in cement, as a rule, and with a metal binding. It comes in widths from 1 to 3 inches usually double thick as to bristle stock.

Fitch Flowing Brush, Plate 40.—This brush is commonly made of soft, black Chinese bristle, or skunk hair, which is called fitch hair. Such brushes are used by furniture finishers for putting on flat color coats

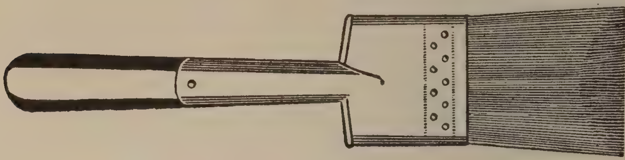


Plate 40.—Fitch Flowing Brush

and similar finishes which require fine brushing to avoid brush marks.

Badger Flowing Brush, Plate 41.—This brush is sim-

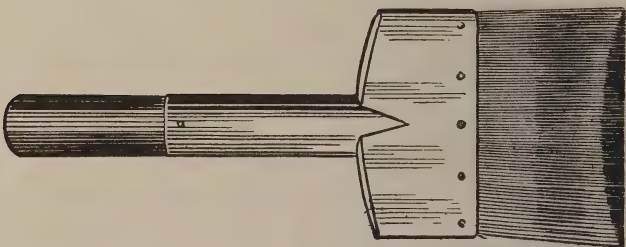


Plate 41.—Badger Flowing Brush

ilar to the previous two described above but is made of badger hair for a casing and the center of the brush is filled with soft French bristle. This is a very elastic brush mostly used by automobile painters for flat color coats and color varnish, or finishing coats. The house painter has little use for these brushes except when he turns his hand to a job of finishing on furniture or exceptional interior architectural finishing.

Flat Color Brush, Plate 42.—These are called camel-hair brushes but are made of squirrel hair. They are

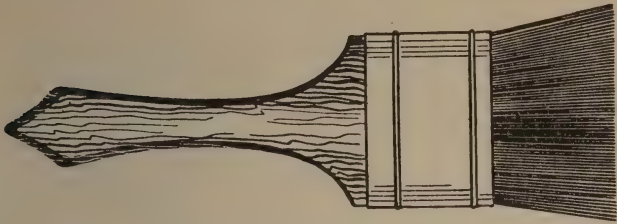


Plate 42.—Flat Color Brush

usually brass bound and set in cement. The sizes vary from 1 to 3 inches and they are used chiefly for brushing on Japan colors thinned with turpentine on furniture and automobile surfaces.

Badger Hair Blender, Plate 43.—These brushes are

Plate 43.—Badger Hair Blender

used by the painter only when doing a job of graining. They are finely constructed brushes of soft badger hair, 3 to 4 inches long. They are made in widths of 2½ to 4½ inches. The bristles are bound in knots and securely wired or cement set into the wood handle. This brush is used to blend out the grain figure which has been drawn in on a piece of graining work.

Graining Stipplers, Plate 44.—These brushes are used also by a painter when doing a job of graining, and they are sometimes called walnut stipplers. The bristles

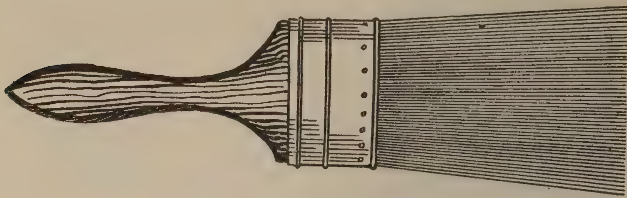


Plate 44.—Graining Stippler

are very long and usually light in color. The brushes are made in widths of 3, 3½ and 4 inches. The brush is used to stipple a job of water color graining with distemper color before the grain figure is drawn in with a fitch.

CHAPTER III

MECHANICAL SPRAY PAINTING EQUIPMENT

The application of paint, varnish, enamel, calcimine, mill whites and other decorative and protective coatings by mechanical means, spray guns, is being done on an extensive scale today because it is both practical and profitable; furthermore, spray painting is an economic factor contributing to the greater conservation of property which must be reckoned with.

In the light of these facts it is essential that any instruction in house painting methods should include a consideration of spray painting. There are a number of scientifically designed and constructed spray guns on the market today, and while the operation of each one is most successful when the instructions of the manufacturer of the particular gun you have are closely followed, there is considerable instruction which is common to all.

The details concerning spray painting methods are presented in Chapter XV. This chapter will be devoted to illustrations and descriptions of the various mechanical units which are essential to a complete spray painting outfit.

A complete spray gun outfit consists of the following units for house painting and similar surfaces:

A. One or more spray guns supplied with air and material from the same compressor and power unit.

B. Air compressor, or pump.

C. Automatic governor unloader.

D. Air storage tank.

E. Power unit—gasoline engine or electric motor.

F. Paint storage tank.

G. Air and material regulating device.

H. Agitator for material which doesn't remain in suspension long—bronze and red lead paints, etc.

I. Air and material hose and connections.

Electric material heaters, special water and oil separators and air dusters are used for some special kinds of work.

Spray Guns, Plates 45, 46, 47, 48, 49.—The spray gun of today is a far superior tool to that of only a few years back. The better types are designed by able engineers and constructed with great mechanical precision. Such guns constructed along scientific lines handle with ease and certainty all manner of liquids, light and medium heavy paste paints. These tools in some plants are spraying the new cellulose lacquers which dry so quickly that they cannot be applied with a common brush. And the other extreme is the spraying of heavy enamels, varnishes, asphaltum, japans and even red lead paint weighing up to thirty-three pounds to the gallon. With this wide range of utility the spraying of house paints on interior and exterior surfaces is an easy accomplishment for the most improved spray guns.

Each of many manufacturers makes a different type of spray gun, but all are quite similar in a general way. Principles and details of construction of many of the guns are covered by patents and, of course, as with other machinery, some guns are more successful than others.

Air Compressors, Plate 50.—This machine is simply an air pump built for heavy duty. Such compressors have been used for a great many years for many purposes. Ice-making machines, pneumatic riveters, sandblast machines, vacuum cleaners of large type and many

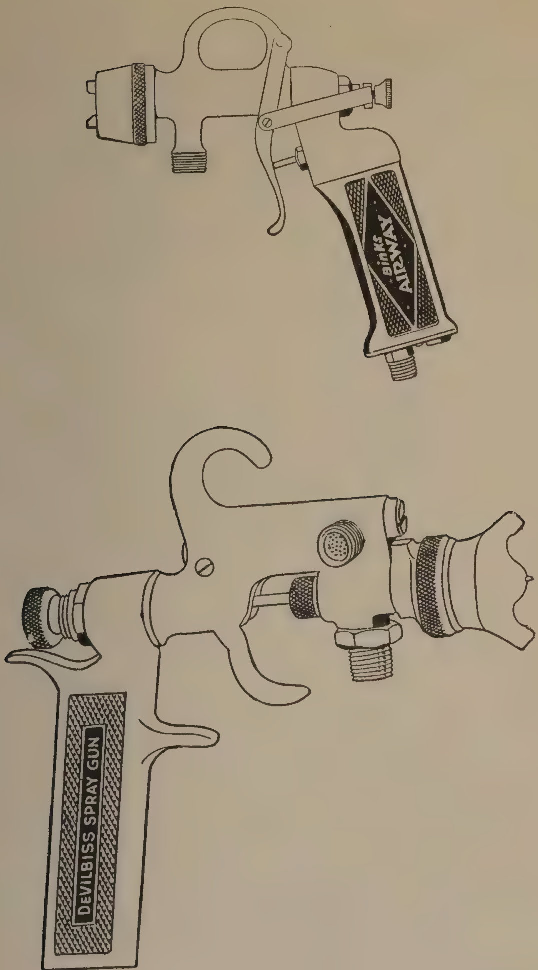


Plate 45.—Binks No. 105 Airway Paint Gun (top)
DeVilbiss Type A Spray Gun (bottom)

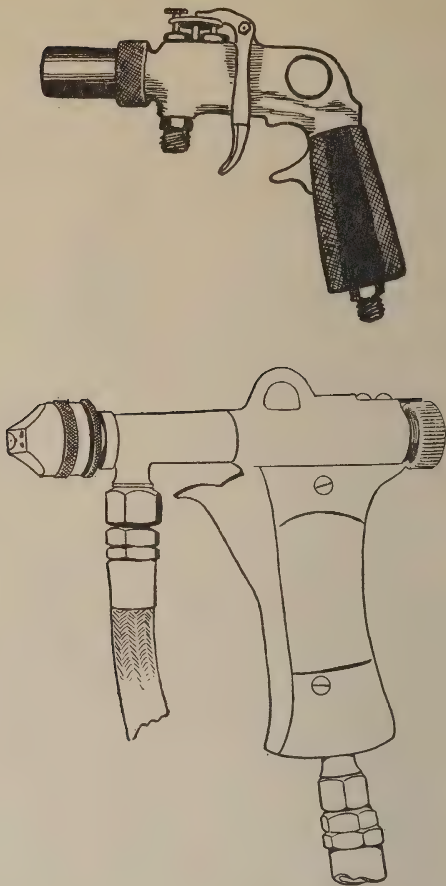


Plate 46.—Matthews Material Gun, Volume F, (top) Beach Model A-1 Air Brush (bottom)

other machine equipments use the same type of compressor. The compressor simply sucks in air, compresses it and delivers it to an air storage tank and from there to the spray gun through a rubber hose.

Compressors are made in many sizes. Some are air-cooled like a motorcycle engine and some are water-cooled. The compressors used on house painters' spray equipment are driven by a belt attached to a gasoline

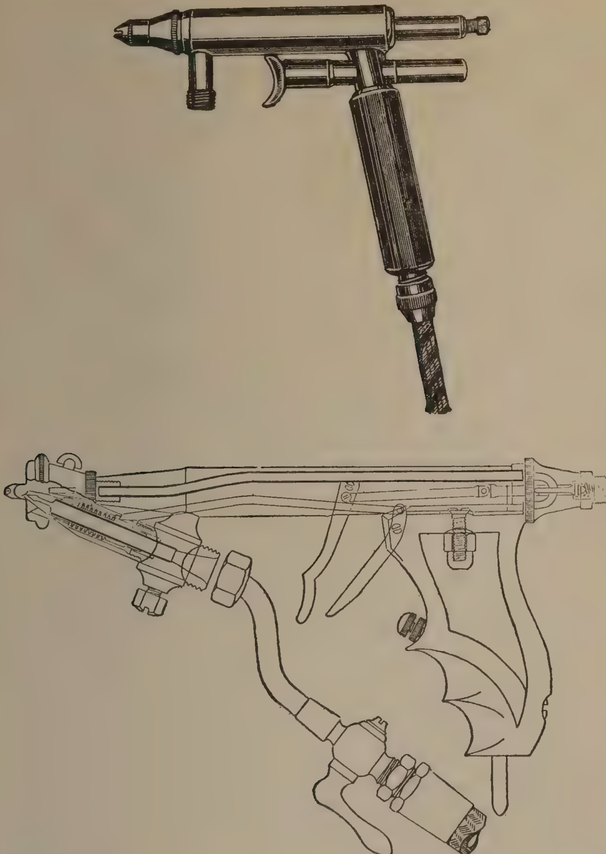


Plate 47.—Wold Air Brush D-1 (top)
Paasche Air Brush Type N&S (bottom)

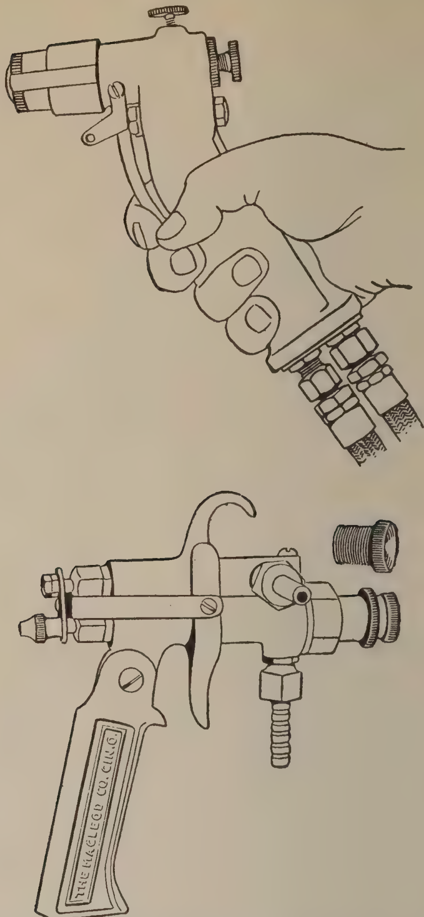


**Plate 48.—Sprayco Model 7-A Paint Gun (top)
MacLeod Paint Sprayer (bottom)**

engine or an electric motor. When used in the shop on a permanent location instead of as a portable machine, the compressor may be driven by a belt from a line shaft.

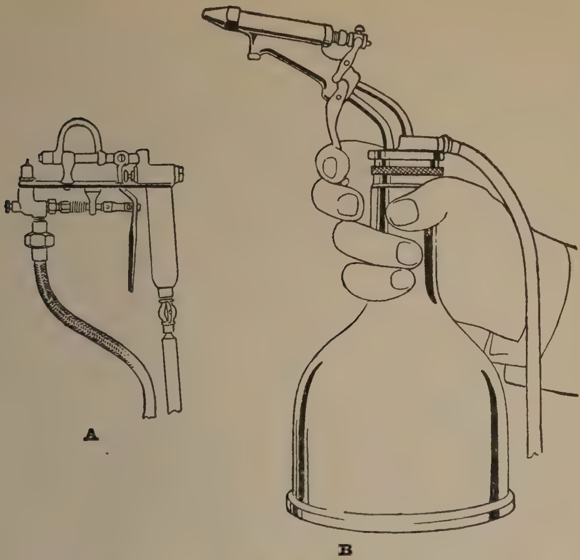


Plate 49.—(A) Eureka Spray Gun 135
(B) Simons Paint Spray Brush

A spray gun used for furniture and automobile painting, for decorating interior trim, walls, floors and other surfaces of small area doesn't require so large a compressor or air storage tank as a gun used for coating large surfaces. A compressor and air storage tank must be larger when two or more guns are to be operated from it at the same time. This is obvious since each compressor has a certain capacity determined by the size of the cylinder and the speed at which it is run.

Air compressors are equipped with a hand unloader, or valve, which enables you to take the compression off of the cylinder while starting the engine or motor.

The air intakes on the compressors are covered with fine wire screen to prevent entrance of dust and other foreign substances which might clog the air line or spray gun valves.

An air compressor is called upon to do heavy work. The bearings of the better machines are die-cast bushings of bearing metals or bronze and are easily replaced or scraped and refitted when wear occurs. The crankshafts are dropforged steel, accurately machined and balanced. Lubrication is the life of this machine. The crankcase is oil tight and lubrication is automatic by the splash system, like automobile engines, and requires only that you keep the case filled with oil up to the overflow

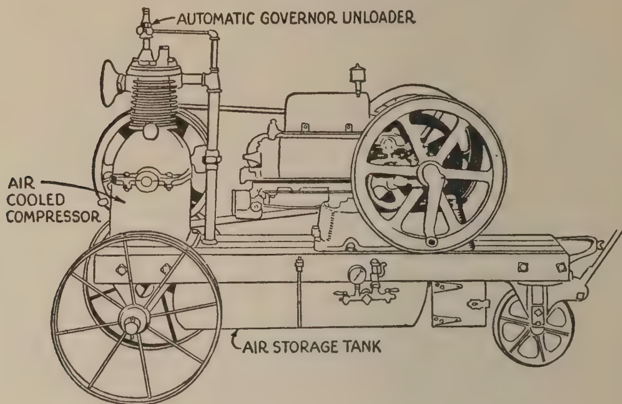


Plate 50.—Air Storage Tank, Air Cooled Compressor and Automatic Governor Unloader

cup level. Then the bearings, piston and cylinder walls are lubricated by splash.

Automatic Governor Unloader, Plate 50.—As a means of safety a blow-off or pop valve is provided on compressors. If neglected, a compressor might be run by the engine or motor until a pressure is built up in excess of the strength of the pipe line or air storage tank and something would blow up, just as a steam boiler would blow up if it were not kept within its capacity by the blow-off safety valve on it. The automatic governor

opens up of its own accord when the pressure reaches the safety limit.

Air Storage Tanks, Plate 50.—A spray gun can be operated by air connection direct to the compressor. In fact, some of the small spray gun outfits for furniture, automobile and interior house trim are so constructed. Spray guns used on large surfaces and which are operated to capacity for many hours at a time, however, require an air storage tank with a reserve air supply.

An air storage tank furnishes an air supply reserve and allows a temporary consumption of compressed air in excess of the capacity of the compressor. Then when you shut off the spray gun for a few minutes to refill the paint storage tank or do a bit of cleaning or bristle brushing on a window sash, the compressor keeps right on running and thus builds up a reserve air supply in the air storage tank.

The air storage tank also prevents pulsations in the air line, making a steadier flow of air. Such a tank provides a condensing chamber where oil and water in the air can be precipitated and drained off. The air compressors sucking in damp air are bound to squeeze out some water by condensation which if it got into the material storage tank, hose or spray gun would cause a little trouble. Also the compressor using oil as it must to lubricate the piston and cylinder walls is apt to discharge a little oil spray with the air storage tank. So water and oil separators are essential in one form or another.

Air storage tanks are made in many sizes, but, of course, you can depend upon spray gun manufacturers to supply tanks of proper capacity to balance up your equipment. That is a simple engineering problem.

A pressure gauge is attached to the air storage tank to indicate the supply of air at hand.

Power Units, Plate 50.—The air compressor requires power supplied by an engine or motor. The portable

spray gun outfits are usually equipped with an electric motor or gasoline engine which drives the compressor with a belt as a rule.

For an outfit having the air capacity to supply one spray gun a gasoline engine of 1½ horsepower is used. A 3-horsepower engine is needed to drive the larger compressor used for outfits supplying two spray guns with air. Some manufacturers supply horizontal engines and others supply the vertical type. Both water and air-cooled engines are used. The better outfits have magneto equipment to supply the spark for the engine and also speed control of a positive type with the gasoline throttle to assure steady power.

Electric motors are more convenient to use and all manufacturers supply them. The small spray gun outfits for shop and building interior use on furniture, walls, wood trim, signs and automobile finishings are operated by small motors of ¼ or ½ horsepower which can be connected to any electric light socket. The larger equipment using motors 1½ horsepower for one-gun outfits and 3-horsepower for two-gun outfits must be connected to power lines rather than to ordinary light sockets. This is possible in factory and other large buildings, as a rule, and also in residence buildings in which electric ranges are used for cooking. For farm painting and painting in general with portable spray gun equipment the gasoline engine power is most useful.

Paint Storage Tanks, Plate 51.—The paint or material supply tanks are made in various sizes. The cup type which is connected to the spray gun directly will usually hold ½ pint, 1 pint or 1 quart of paint or other material. The larger portable tanks which may be carried up on to a scaffold or roof or allowed to remain on the ground are made to hold 1, 4, 7, 8, 14, 20, 30 and 50 gallons of paint. All manufacturers do not make all sizes, but each one offers ample choice of sizes for all practical needs.

Most paint storage tanks are made of seamless pressed steel with welded bottoms, but some have riveted seams. The interiors are smooth and bright and the openings at the top are of ample size to permit easy and rapid

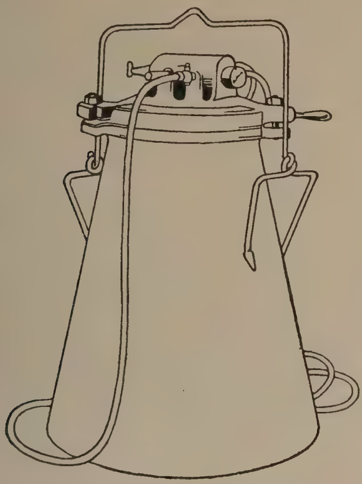


Plate 51.—Paint Storage Tank

cleaning. Some tops are screwed on with accurately machined threads while others are clamped down tightly with levers. Usually the pressure regulating device and pressure gauge are part of the tank cover unit.

Some of the larger paint storage tanks are mounted on wheels and are equipped with a handle while others are made with convenient handles so that they can be easily carried up on to a scaffold or roof.

These tanks are also made in the form of a knapsack to be carried on the painter's back. A convenient arrangement for staining or painting roofs, domes, smoke stacks, columns, steeples, etc. A 3-gallon capacity is about as large a load as a man wants to work with for a tank of this kind.

The tanks having a capacity of 1, 4, 7, 8, 13 and 14 gallons are the most commonly used for house painting purposes, depending upon the size of the job, quantity of paint mixed, etc.

A moderate air pressure is placed upon the paint in the storage tank, usually just enough to force the paint to run out of the spray gun nozzle in a steady stream. Such pressure can be regulated usually by the valve on top of the tank.

Air and Material Regulating Devices, Plate 52.—The material which may be paint, stain, varnish, enamel or other protective or decorative coatings is put into the paint storage tank and from there is forced through the rubber material hose to the spray gun. Some materials require considerable pressure—up to 50 or 60 pounds for the very thick, heavy pastes, while thin stains and light weight paints require very little pressure to force them to the spray gun. More pressure on the material in the tank is needed when the spray gun is working high up on a two or three story wall or roof than when working on the ground, no matter what material is being used. To make it unnecessary to carry high pressures in the paint supply tank the tank is usually carried up on the scaffold or roof so that the spray gun is not used more than 25 or 50 feet above the material supply. Much less air is needed to force the paint up to the spray gun than is required to atomize the paint at the nozzle for spraying purposes. Your spray gun has two rubber hose lines leading to it. One hose carries the paint and the other nothing but air.

For the best work it is necessary to maintain a steady pressure of air on the paint in the storage tank. Your air storage tank will deliver to the paint storage tank much more air pressure than can be used. It is, therefore, necessary to have a regulating device on a paint tank to admit a steady flow of air and maintain the desired pressure.

The paint storage tank on most of the spray gun outfits has mounted on the cover an air controlling device and a pressure gauge which indicates the pressure of air on the material in the paint storage. On this regulating head is also mounted, as a rule, a second air pressure control device and a pressure gauge which control and indicate the amount of pressure carried in the air line hose which leads from the air storage tank to the spray gun. The trigger on the spray gun will control the air pressure and paint supply to better working results when both air and material are regulated to a steady flow before reaching the gun.

In other words, instead of carrying an air line hose from the air storage tank directly to the spray gun, this line is usually carried to the regulator and pressure gauge on the regulating head which is a part of the paint storage tank. Then, one air line hose and material line hose are carried to the spray gun from the regulating head. Some manufacturers use a somewhat different mechanical arrangement, but the result is the same in the respect that both the air pressure and the material supply to the gun are regulated for a steady flow. What this regulating device does is to take this high pressure of 100 or 200 lbs. of air in the air storage tank and reduce it to any desired pressure from 1 or 2 pounds to 20, 50 or 60 pounds commonly used.

The regulating or control head not only distributes air pressure and prevents paint from backing up into the air line hose, but also controls the speed at which your spray painting is done. You can set the air and material pressures so that you can paint a surface slowly or with great speed.

Material Agitators.—Some kinds of paints, when being used with a common bristle brush, must be stirred every few minutes to prevent the pigment from separating from the liquid. Materials which have a pigment that does not remain in suspension—such as bronze

paints and red lead metal paint—must be agitated in a paint storage tank of a spray gun equipment. This agitation to prevent the pigment from settling in the bottom of the tank is usually accomplished by introducing a stream of air which is discharged at the bottom of the tank and which, consequently, keeps the pigment and liquid stirred and in suspension all the time. Some paints require more agitation than others. For this reason the agitating device can be regulated by a valve or thumb screw device which may be set in whatever position you find necessary to keep the paint thoroughly mixed.

Extension Spray Gun Handles.—When using the spray gun in an ordinary manner it is not necessary to get as comfortably near to the surface as when using the common type of brush. To reach out-of-the-way places, however, without extra scaffold equipment, extension handles in various lengths of about 3, 6 and 9 feet are supplied. With such a handle attached to the regular spray gun the painter can reach high places comfortably without risk and do a good job of spray painting without building up more scaffold.

Extension handles are especially useful for reaching surfaces in back of pipes on interiors, for painting flag poles, steeples, domes, and for reaching high ceilings of room interiors, while working from the floor without scaffold. In the latter kind of work a great deal of time is saved by working from the floor and, of course, the cost of handling the scaffold is saved. The spray gun is controlled from the lower end of the extension handles quite as effectively as when operating the guns with the regular handles.

Hose and Connections, Plate 52.—To carry the air supply from the air storage tank to the paint storage tank a flexible rubber hose usually red in color is used. Then, to carry the air supply from the regulating head on the paint storage tank to the spray gun another red

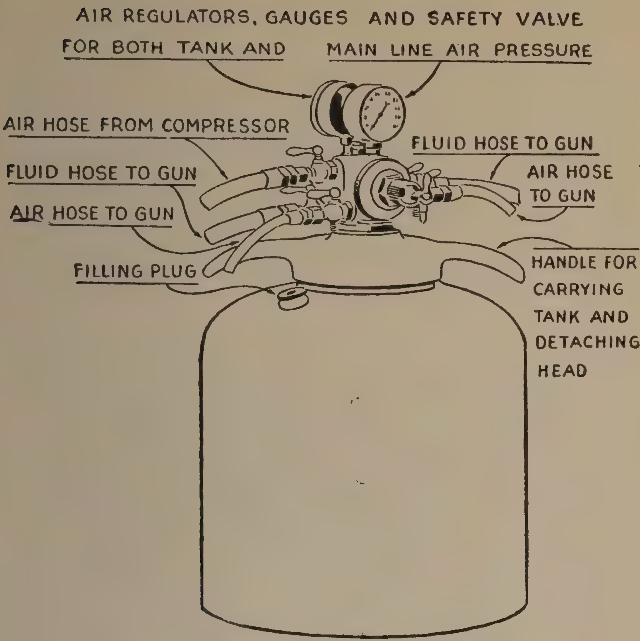


Plate 52.—Air And Material Regulating Device

rubber hose is commonly used. To carry the paint or other material from the paint storage tank to the spray gun a third hose usually black is needed. Such hose is assembled in 25 and 50 foot sections with tight fitting connections. Any number of these sections can be connected in order to assemble any desired length of hose for reaching high roofs or for operation when the compressor and power unit is placed in a basement while the spray guns are being used in the upper floors.

Hose which is specially constructed for this purpose should be used. Common garden hose soon goes to pieces on the inside when in contact with paints and other materials sprayed. Then, little pieces of rubber

break off and clog the spray gun, causing loss of time for cleaning.

Oil and Water Separators, Plate 53.—Moist air when compressed and stored in the air storage tank is apt to liquify to some extent and condense water in small amounts in the air line. Accumulations of such water

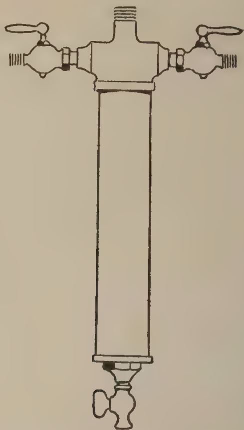


Plate 53.—Oil and Water Separator

and of oil, dust or dirt coming through the air compressor, are a detriment to fine finishing, especially of varnish and enamel surfaces.

Some spray gun outfits built for the painting contractor to use on exterior and interior surfaces to be coated with ordinary paint, enamel, mill white, calcimine, stains, etc., do not require a separate oil and water filtering device, because oil, water and dirt are separated from the air by the air storage tank construction. Other manufacturers furnish the oil and water separating device as a separate unit for all ordinary painting purposes as well as for fine finishing with varnishes and enamels. It is essential that oil, water,

dust and all gritty particles be removed from the air spray going to the spray gun in order to avoid clogging and to secure clean coatings without discolorations.

Trucks and Skids, Plate 54.—The portable spray gun equipment in which the painting contractor is interested is assembled in two ways by the manufacturers. One outfit composed of the air compressor, engine or motor, air storage tank and pressure gauge is mounted on a truck having small wheels and a handle by which this

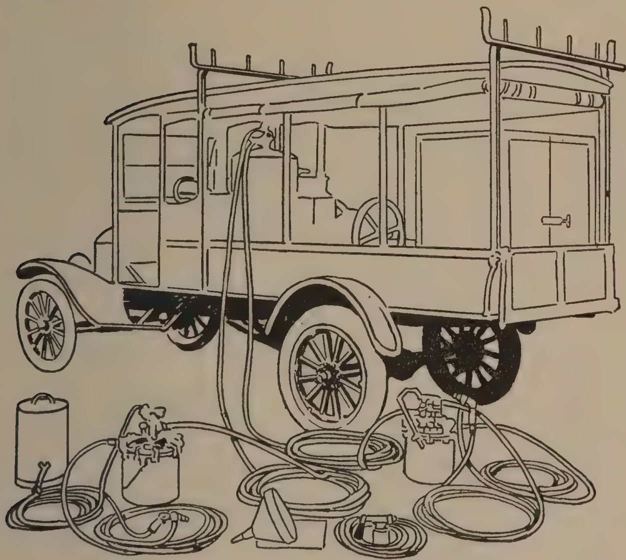


Plate 54.—Air Compressor and Power Unit Mounted on a Truck

unit can be easily and quickly moved from place to place.

The other assembly of the same units is secured to heavy wood or steel skids so that the complete outfit can be installed on an automobile truck for transporta-

tion. With such an outfit the truck is usually run as near to the building as possible and only the spray gun, air and material hose and paint storage tank are taken into the building or upon the scaffold from which the building is being painted on the outside.

Whitewash and Spray Pumps, Plates 55 and 56.—Such machines have been in use for many years. As constructed today with brass cylinder, bronze valves, seats and other working parts to guard against corrosion from any liquids sprayed, these pumps are substantial and successful, indeed, for certain classes of work. They are not, however, designed for spraying oil paints or any heavy liquids and do not operate satisfactorily in such service.

The machine pictured in Plate 55 is a convenient type which is equipped with an air chamber to assure a steady pressure at the spray nozzle. The pump

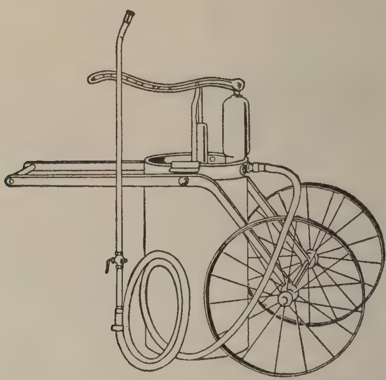


Plate 55.—Whitewash Spray Pump

handle, of course, is operated by hand and when in motion the pump sucks in the material and forces it through the discharge hose line to the end of which the spray nozzle is attached. This nozzle has a lever

shut-off cock control which allows the material to be fed to the nozzle only as fast as it can be atomized and sprayed onto the surface as wanted.

These machines are used extensively for decorating large rooms in factory, warehouse and other industrial buildings with whitewash, cold water paints, calcimines, etc.

The machine sprayer shown in Plate 56 operates by compressed air and in a different manner than the whitewash pumps just described.

These tank sprayers are useful to the painter in

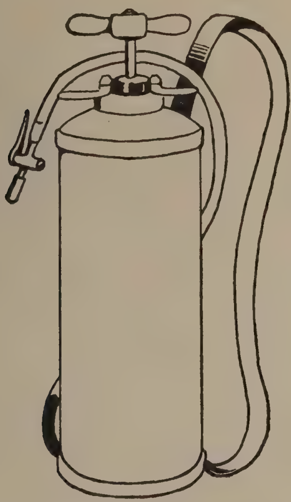


Plate 56.—Spray Tank and Pump

many ways. They are used to spray a fine water mist on to wall paper to be scraped off and that speeds up the work considerably. They are used by some decorators to spray on glue size and also for coating new walls with calcimine. They do not operate satisfactorily, however, for coating old dark walls with calci-

mine. This sprayer has also been used for the application of stain coats on shingle roofs.

This type of sprayer is operated by putting the material to be sprayed into the tank. The top is screwed on tightly and the tank is pumped up to the air pressure needed to force the material out in a spray through the hose and nozzle control on the end of the hose. The strap secured to the spray tank permits the operator to carry the outfit on his back while spraying. This sprayer is not suitable for oil paints or any thick liquids.

CHAPTER IV

LADDERS, SCAFFOLDS AND SWING STAGES

Claim to the interest of painters and decorators in correct scaffolding and ladder equipment and the proper use of it is made for more than one reason. Knowledge along this line is very important.

One may devise various methods for reaching surfaces to be painted and decorated, but not all of these means are safe, convenient or profitable.

The first essential is to learn to avoid unnecessary risks to life and limb. The first law of nature—self-preservation—one might think should be sufficient to make men take the necessary care and be foresighted enough to eliminate dangerous scaffolding. It is not, however, as is abundantly proved by the many newspaper reports one sees of accidents in the building trades. Most accidents are preventable and would not occur except for carelessness, for the human trait which proves that familiarity with danger breeds contempt for it.

The largest part of the cost of doing the average job of painting and decorating is labor cost. Much time and expense are wasted, often, in getting scaffold equipment to the job and erected in place in time to avoid having high priced mechanics standing around waiting to get at the surface.

A painter works most efficiently in a space not higher than his breast, nor lower than his knees. He paints more surface working from the ground than from scaffold. Therefore, the more nearly these ideal conditions

Plate 57.—Painters' Trestles

can be approximated by having sufficient scaffolding correctly placed to give a mechanic a sense of security and solid footing the more work he will do; and he will do his work with less loss of his physical energy than when he must constantly over-reach to coat some surfaces of the job.

In the most efficient paint shops of the larger size a specially trained crew of men put up all the scaffolding on the jobs; these helpers also remove the equipment, leaving the painters only the task of preparation of surfaces and painting them.

DESCRIPTION OF EQUIPMENT

Painters' Trestles, Plate 57.—While doing a job of interior painting and decorating the scaffold most commonly used to reach ceiling and upper side walls are those made by placing 2, 4, or any number of trestles required in position and then locating planks on the top or lower rungs, as indicated in the illustration. These trestles are similar to the common type of stepladder except that trestles are made with round rungs instead of flat steps and, of course, a trestle has no platform at the top. Trestles are made practically with a hinge joint at the top. These trestles are made in lengths of 6, 7, 8, 10, 12, 14 and 16 feet.

Some trestles are now made with steps on one side like a stepladder and round rungs on the other side. See Plate 58.

Trestles are also used for outside painting to some extent for carrying planks to reach upper side walls of one-story cottages.

Steel Trestles.—Trestles are being used to considerable extent now which are made of steel similar to that pictured in Plate 59. These trestles are collapsible, rather light in weight and will support great loads. They are, of course, fireproof and have a much longer life than wood trestles. It is easier to transport them

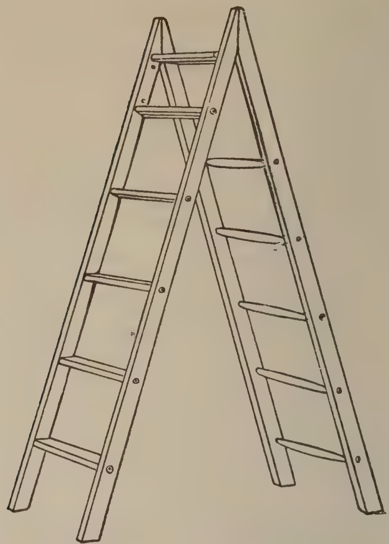


Plate 58.—Combination Trestle and Step Ladder

from one place to another and they require less room for storage. They are practically unbreakable. The standard steel trestle is made in the following sizes:

2 ft. high x 3 ft. wide
3 ft. high x 8 ft. wide
4 ft. 6 ins. high x 5 ft. wide
5 ft. high x 5 ft. wide

Steel trestles are also made in an adjustable type, as indicated by Plate 60. These trestles are made 3 ft. high x 5 ft. wide with a 2 ft. adjustable raise; also 4 ft. high x 5 ft. wide with a 3 ft. adjustable raise.

Plate 59.—Steel Trestle

Plate 60.—Adjustable Steel Trestle

Stepladders, Plate 61.—For the use of paperhangers and decorators the common stepladder with flat steps, instead of round rungs, is most convenient and, of

Plate 61.—Step Ladder

course, the flat steps are more comfortable to stand on where one must work from the steps for any considerable length of time. The best types of stepladders are made with steel rod reinforcements through or under each step. Step ladders are made in sizes of 5, 6, 7, 8, and 10 ft. long.

Single Ladders, Plate 62.—The long ladder commonly

used by painters is familiar to all and it is indispensable for exterior painting. It is possible, of course, to paint practically all of the surface of the average one- or two-story residence by using long ladders, but

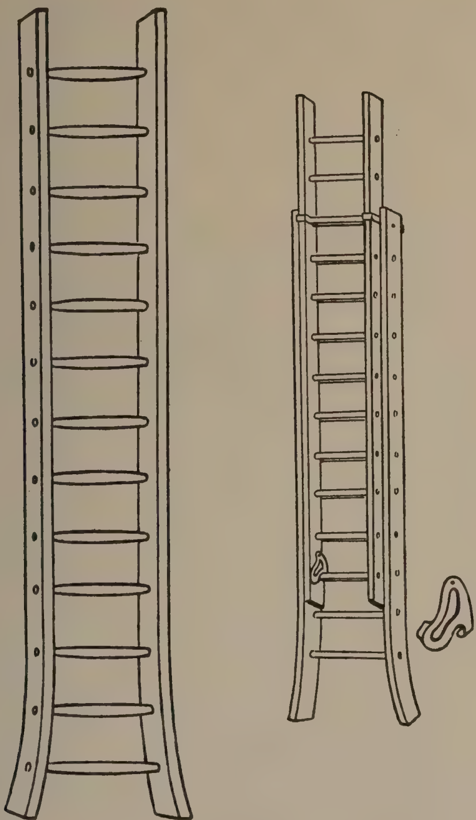


Plate 62.—Single Long Ladder

Plate 63.—Extension Ladder

it is more comfortable and convenient and saves time to work from planks extended from ladder jacks or suspended by other means. When working from a ladder the painter cannot reach much surface from one sitting and, consequently, is compelled to climb up and down the ladder a great many times every hour when working in this manner. A man can work much faster and more comfortably from planks resting on trestles, on ladder jacks fastened to long ladders and upon a swing stage platform for the higher buildings with large surfaces. Long ladders are not, therefore, used for large surfaces even though they easily reach such areas.

High class long ladders are made of sound Norway pine or spruce, as a rule, and have turned hickory rungs. The rungs are mortised into the side rails and securely nailed, screwed or bolted in place with long bolts which run the full length through the center of the wood rungs. Long ladders are made in lengths of 8, 10, 12, 14, 16, 18 and 20 ft. The best design is that having a bottom which is much wider than the top.

Extension Ladders, Plate 63.—Such ladders are made practically the same as long ladders described above except that they are the same width at the top as at the bottom. These extension ladders are made to attach to long ladders, using a mechanical device, shown in the illustration, with which to fasten the two or more sections together.

Extension ladders of the two-section type reach from 20 to 40 feet, while the three-section type reaches from 30 to 60 feet.

Scaffold Planks.—The planks most commonly used are 8 and 10 inches wide, preferably the latter, and they must, of course, be first class sound lumber of considerable strength. The lumber must be free from knots and other imperfections which lessen strength.

Extension Planks.—There are on the market extension planks which are decidedly convenient to use.

They occupy half the storage space of ordinary planks, are lighter in weight and are just as strong. These planks are made in three sizes: 6 ft. long which opens to 10½ ft.; 8 ft. long which opens to 14 ft.; 10 ft. long

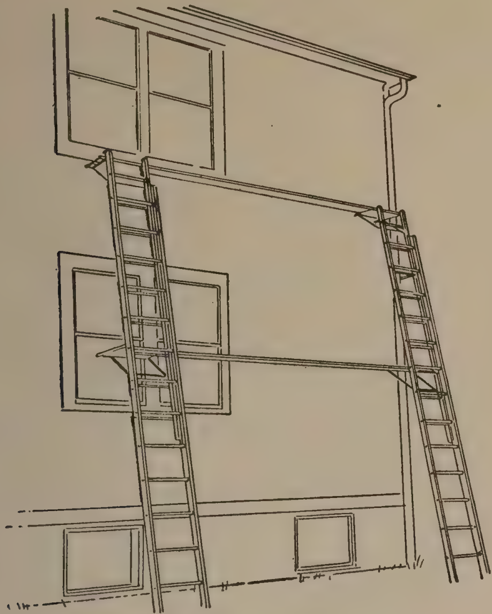


Plate 64.—Platform Ladders

which opens to 17½ ft. These planks are 11 inches wide. See Plate 57.

Platform Ladders, Plate 64.—This modern form of extension ladder enables two or more men to work on the two platforms with safety, speed and comfort. By using two or three of these ladders with extension planks a scaffold is erected quickly from which a great deal of surface can be reached conveniently. The planks used with these platform ladders are 14 ft. long

and are trussed with steel. These trussed planks are also made in 12, 16 and 18 foot lengths.

The platform ladder has a lower section 14 ft. and an upper section 10 ft. long. The upper section carries two platforms about 2 feet square, 6½ feet apart. The ladders are light enough to be handled by one man and yet strong enough to carry the load of several men.

Ladder Extension Feet, Plate 65.—When ladders

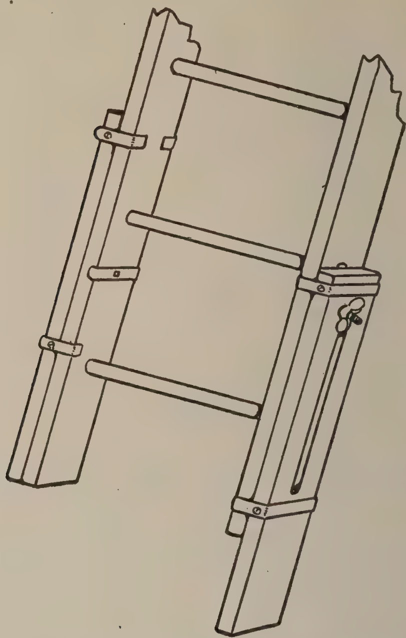


Plate 65.—Ladder Extension Feet

are used on exterior work where the ground is not level, because the lawn is terraced, it is often difficult to gain a secure footing for both legs of the ladder without digging a hole in the grass or blocking up one leg more or less insecurely. The extension feet illus-

trated here may be used under these circumstances and will permit you to place the ladder level and securely.

Steel Ladder Shoes, Plate 66.—These are simple metal

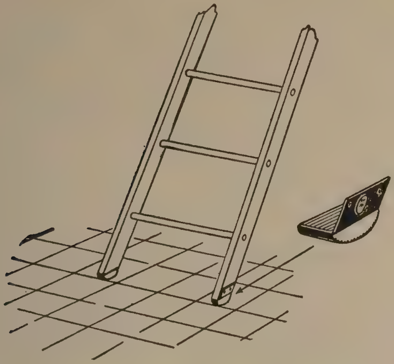


Plate 66.—Steel Ladder Shoes

plates to be securely fastened on the bottom of long and extension ladders so that the ladders may be safely placed upon cement sidewalks, drives and roads where a footing is not always safe.

Rung Repair Plate, Plate 67.—One who makes care-

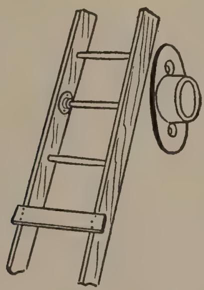


Plate 67.—Rung Ladder Repair Plate

ful inspection of ladders often finds need for these little metal plates which enable the painter to make a permanent repair of a rung which has been broken out of a ladder by some unusual shock or strain.

Ladder Brackets, Plate 68.—There are several styles of metal ladder brackets made for the purpose of sus-

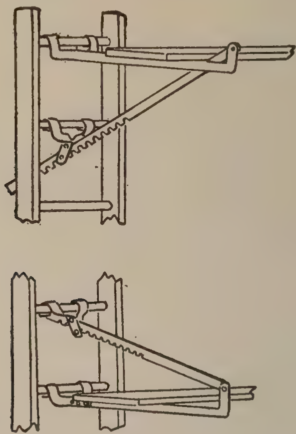


Plate 68.—Ladder Brackets

pending planks from extension ladders and long ladders. Some of these brackets are attached to the rungs of the ladder, while others are secured to the side rails and would seem to be safer if there are any defective rungs in the ladder used. These brackets may be fastened to the underside of ladders, as indicated, or they may be used on the outside from which to suspend planks in that position.

Roof Ladder Hooks, Plate 69.—Such metal hooks as are shown are fastened to the top of the ladder used on roofs which have considerable pitch. The hook is fastened over the ridge of the roof.

Window Bracket, Plate 70.—This device is simply a

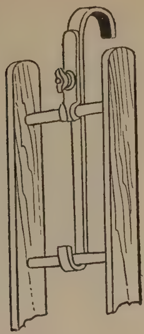


Plate 69.—Roof Ladder Hook

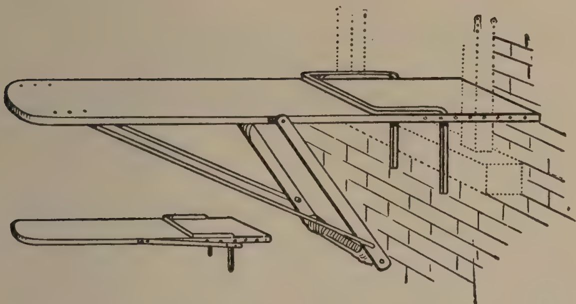


Plate 70.—Window Bracket

plank which can be extended from a window sill to enable a painter to work on the outside of the window without a swing stage. These are used, of course, only where the windows are too high to reach with a long ladder and where the windows are numerous enough in a straight line on a wall to make the use of a swing stage the most convenient method of reaching the surface.

Adjustable Folding Scaffold, Plate 71.—In this equipment the painter is supplied with folding adjustable scaffold which is very strong and useful in many ways.

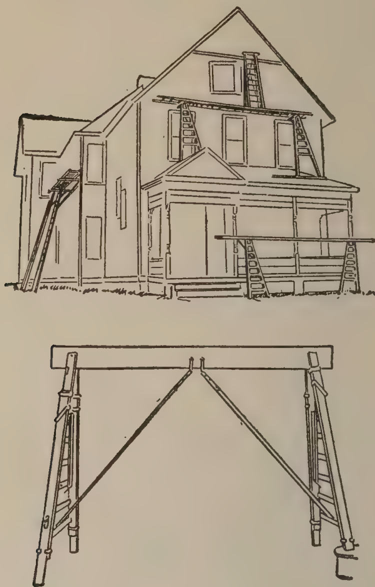


Plate 71.—Adjustable Folding Scaffold

Used for both interior and exterior surfaces as indicated in the illustration. The legs may be extended. They are made in three sizes:—$3\frac{1}{2}$, $6\frac{1}{2}$ and 12 foot. The $3\frac{1}{2}$ ft. scaffold extends to 6 feet high; the $6\frac{1}{2}$ ft. scaffold extends to $10\frac{1}{2}$ feet high; the 12 ft. scaffold extends to 21 feet high.

Plate 71-A shows a new safety extension trestle.

Plate 72 shows special scaffold units to be assembled for any job.

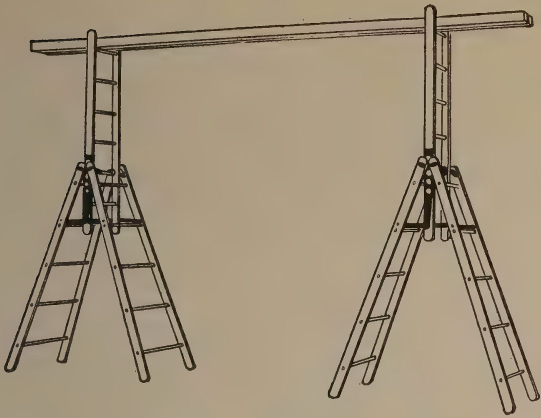


Plate 71-A.—Safety Extension Trestle

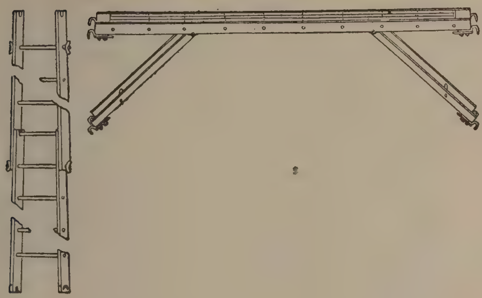


Plate 72.—Special Scaffold Units to be Assembled for Any Job

Ladder Bracket, Plate 73.—An attachment of recent design which, when secured to the top of any rung of a ladder, makes a secure platform. Planks may be extended from two or more of these platforms to make a secure stage from which to paint. Useful also on steep pitched roofs.

Safety Ladder Bracket, Plate 74.—These are malleable iron attachments which fasten to the top of long

Plate 73.—Ladder Bracket

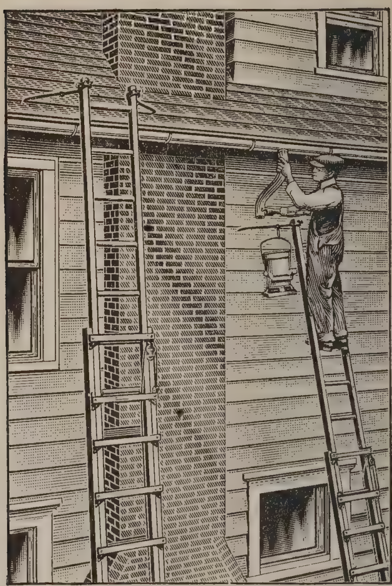


Plate 74.—Safety Ladder Bracket

ladders and extension ladders with thumb screws. They are designed to straddle windows enabling the painter to trim sash and frames easily. They also steady the ladder.

Adjustable Stepladders, Plate 75.—Similar to ordinary trestles except that they are made with flat steps like stepladders securely fastened in place with irons. Also one side of this ladder has no steps, but is made with legs adjustable in length, so that the ladder may be used on stairs as indicated in the illustration.

Plate 75.—Adjustable Leg Step Ladder

SWING STAGES

See Plate 76. The scaffold equipment needed to reach the upper surfaces on buildings of the three story height and higher is usually a platform suspended from roof or cornice with ropes—swing stages, they are called. This equipment is a very old type used for generations. Little change has been made in swing

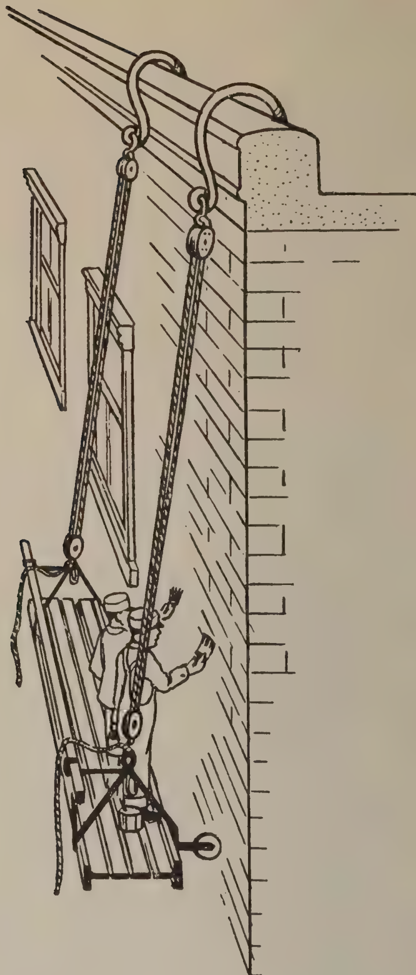


Plate 76.—Swing Stage

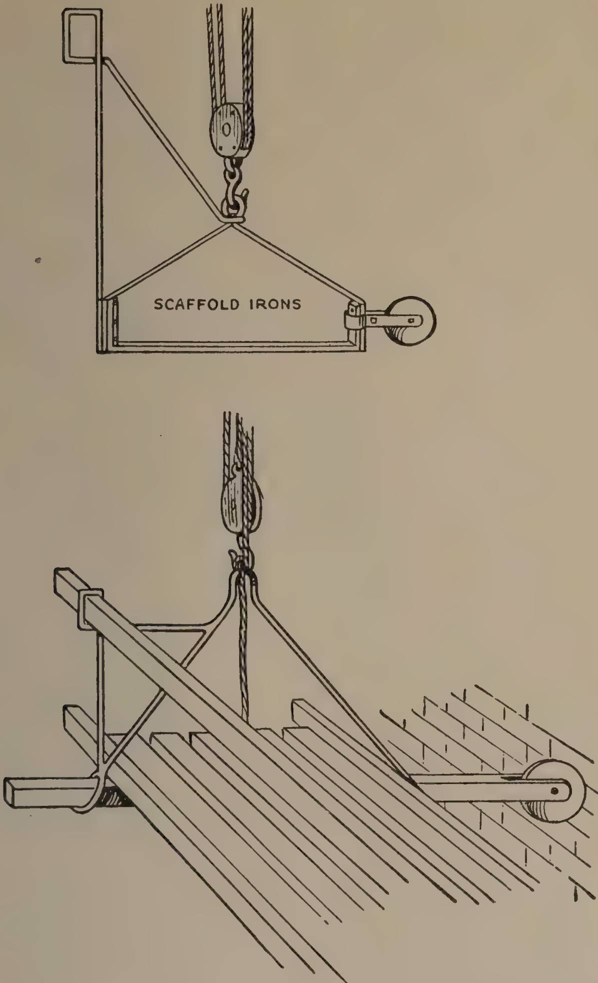


Plate 77.—Swing Stage Stirrups

stages in general design in years, but many needed improvements in details have been made.

Swing Stage Stirrups, Plate 77.—In the illustration the new improved stirrup with safety guard rail and of all metal construction is shown. These new stirrups are made of wrought iron to comply with safety regulation laws and are quite generally used in place of the old wood stirrups.

Swing Stage Ladder Bracket, Plate 78.—Swing stages are sometimes placed where there is no opportunity to use cornice hooks, or where such hooks placed on cornices with wide overhang would swing the platform too far away from the wall to be coated. Under these conditions the ladder bracket illustrated is placed on the top of each of two extension ladders, blocks are then hooked into these brackets and the platform is swung in the usual manner as when cornice hooks are used.

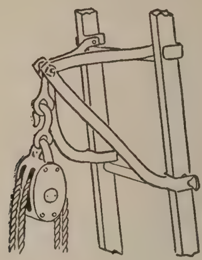


Plate 78.—Swing Stage Ladder Bracket

Cornice Hook Extension Brackets, Plate 79.—Cer-

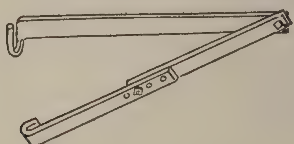


Plate 79.—Cornice Hook Extension Bracket

tain types of store front buildings are made with a cornice dropped a few feet below the top of the brick wall, thus making it impossible to throw cornice hooks over wall or cornice and allow the rope falls to run freely in the blocks. The extension brackets illustrated are made to overcome this difficulty as pictured. The extension brackets are secured to the bottom of the cornice hooks. They project out beyond the cornice.

Pulley Blocks, Plate 80.—Four blocks are needed for each swing stage. A set consists of two single wheel blocks, each with a becket wheel at the bottom to which one end of the rope is tied, and two double wheel blocks as pictured. The blocks reinforced with iron straps are the only safe kind to buy. These blocks are made in

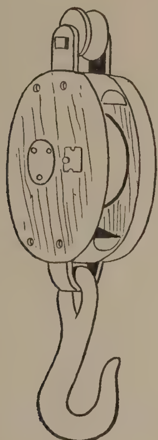


Plate 80.—Pulley Block for Swing Stage Fall Ropes

various sizes for different sizes of rope. A rope 5/8 inch in diameter uses blocks with a five-inch shell; the 3/4 inch rope uses six-inch blocks; the 7/8 inch rope uses seven- or eight-inch blocks. The larger ropes and blocks

are much to be preferred because they carry much greater loads and so the factor of safety is greater.

Swing Stage Rope Falls, Plate 81.—These ropes may be had in any length and only high grade rope should be used,—this is no place to economize. Manila rope is most commonly used. Sisal rope is not safe. The best grade of Manila rope will safely carry these loads:

⅝ inch rope—4,000 pounds
¾ inch rope—4,700 pounds
⅞ inch rope—6,500 pounds
100 feet of ⅝ inch rope weighs about 13 pounds
100 feet of ¾ inch rope weighs about 16½ pounds
100 feet of ⅞ inch rope weighs about 25 pounds

Ropes are subject to variation in quality the same as other merchandise and it is not safe to buy "just ropes." Know what kind and quality you are buying

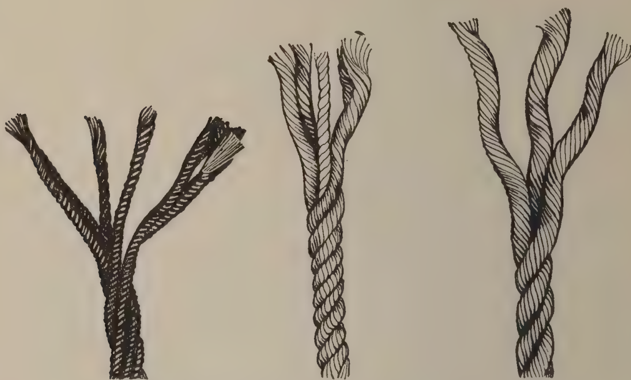


Plate 81.—Swing Stage Rope Falls

and deal only with responsible dealers and manufacturers.

Manila fibre from which good rope is made is not all of the same high quality. Also there are some struc-

tural differences in ropes. Manufacturers make various grades of Manila rope for various purposes. The lower grades are good enough for some purposes but not for swing stages. Be careful, therefore, to name the purpose for which you want to use any rope purchased. The ropes used in the building trades pass through many hands before reaching the men who are to use them. There is more or less ignorance and confusion as to grades and qualities of ropes. The names "standard," "commercial" and "best" may mean anything and not necessarily high quality. Private brand names may also be misleading. The most responsible manufacturers, however, are careful to list ropes also as first, second and third quality. The man who really wants to know what he is buying can learn such information from manufacturers' catalogs in the hands of dealers.

In the illustration, Plate 81, are shown three types of rope. The one on the left is the common three-strand type of Manila rope of good quality used by painters for swing stages. It is satisfactory when the larger sizes—¾ and ⅞ inch—are used. The rope pictured in the center is a five-strand rope which costs only about one cent per foot more than the common grade and is much better. The fifth strand is called the heart or core and it adds considerably to the strength of the rope. The rope type shown on the right is a superior rope used a great deal in hoisting and marine service. It should be used more by painters. This rope costs quite a little more than common quality, but is a good investment at that because in addition to its greater strength and safety it has much longer life. This is a fibre-clad steel wire rope made of five strands. Each of the five wire strands is completely covered with the best grade of tarred Russian hemp marline. The center core or heart has no wire in it. This rope is not too stiff to handle. It will coil down as easily as Manila rope. The fibre covering protects the hands

from injury by the steel wire cables. Such rope is waterproof, rustproof and needs no lubrication. It cannot swell from moisture and jam in the pulley blocks. Dirt and dust cannot get in between strands and grind up the fibres. Fibre-clad rope is much stronger than Manila rope of the same diameter. Fibre-clad rope is about one-third the diameter of Manila rope having the same strength. Smaller blocks are, therefore, used with fibre-clad rope. The weight of fibre-clad rope is about one-half of that of Manila rope of the same strength.

Rope Materials.—Manila hemp and sisal are used for rope making. Sisal is satisfactory for ropes which are not subjected to great loads. Sisal has about 25 per cent less strength than Manila hemp. Sisal makes rope which is less flexible than Manila rope and it also casts off splinters of fibre which injure the hands. The length of this fibre is considerably less than that of Manila. It is usually about three or four feet long while Manila fibre is three or four times that length. Sisal fibre deteriorates in the presence of moisture. Ropes made from Manila hemp are much superior to sisal ropes in strength, flexibility and length of life.

Taking Care of Ropes.—No need to cite the wisdom of caring properly for ropes, the necessity is too obvious. But how to take care of them is not as well known as it should be. Ropes wear out and break for more than one reason. There is internal wear on ropes due to friction of the fibres and strands with each other. Such friction and wear are greatly increased when ropes are not lubricated and when ropes are given sharp twists and bends around square corners.

The external wear on ropes is due largely to accidents;—ropes are pinched under heavy loads, they are squeezed between metal or other hard surfaces. Wear also comes from friction by running the rope through pulley blocks which are too small. Only blocks

with large sheave grooves should be used;—then the rope runs freely even when swollen with moisture. Ropes should not be permitted to scrape against window sills, stone cornice projections, wood beams, scaffold, etc. Also the pulley blocks must be kept lined up. When not in alignment the ropes chafe and wear. Ropes deteriorate from exposure to acids and the weather.

Internal wear on ropes can be greatly lessened by keeping them free from dust, sand and mud. Ropes should not be dragged around but picked up and carried, if you would avoid having dirt grind up the internal fibres.

Storing Ropes.—A clean, well ventilated room is best for storing ropes. Heat is not necessary. Especial care should be taken to keep all acids away from rope. Normally Manila fibre contains a small percentage of moisture and it should not be allowed to get bone dry. This fibre will, however, absorb as much as 30 per cent or 40 per cent of moisture in a damp storehouse. That is too much, although it is not true, as popularly believed, that moisture promotes decay in Manila rope if there is not too much moisture present. An occasional wetting of ropes in very hot, dry weather is beneficial. Water soaked ropes ought not, however, to be covered up;—permit them to dry out naturally. Hang them up to dry. Manila fibre is made more brittle by a freezing temperature. What is called dry rot in ropes is induced by allowing water soaked ropes to be covered rather than hanging them up to dry out to the normal moisture content.

Lubricating Ropes.—Ropes which become too dry get fuzzy and brittle. It is the part of wisdom to lubricate and waterproof ropes and that at the same time seals up the strands so that dust and sand cannot enter between fibres and grind them up by friction. Probably the best lubricant and waterproofing agent is common beef tallow. Melt it in a kettle and while hot swab the ropes

with it. Such lubrication of ropes increases their life to twice that of ropes which are allowed to get dry, dirty, water-logged and fuzzy. Lubricated ropes are also much more comfortable to handle and run more freely in the blocks.

Inspection and Use of Ropes.—Ropes may have been put into excellent condition at the beginning of a busy season, but it will pay just the same to look them over every time they come back to the shop from a job. A rope which has been snubbed around a small square post or a sharp corner and been subject to an overload will come through more than likely with a weak spot—the frayed and thinner strands indicate such weaknesses. And when a rope is thrown over a sharp cornice or other square roof projection to support a heavy swing stage without taking the precaution of using a pad of burlap or carpet on the edge, the rope fibres are sure to be ground together with such force as will weaken the rope.

Ropes running through blocks should not be allowed to touch anything except the pulley wheels in the blocks, —don't let them scrape against the sides of the block sheaves. Don't let the ropes vibrate unnecessarily nor slip over pulley wheels which need lubrication so much that they no longer revolve.

Injury to ropes occurs from a sharp nip of any kind whether due to a bad splice, a bad lead, hitch or short bend around a pin or post. Under these stresses the tension on the outer fibres is very great while the compression on the inner fibres is also great. This unequal distribution of the strain is bad for the life of the rope. Likewise, kinks and knots in ropes are very injurious; —breakage, then, will often occur when only a small strain is put upon the ropes.

Rope fibres have a tendency to slip against each other. The fibres gradually lose their cohesion when subjected to excessive loads repeatedly or in a sustained manner.

It is well to provide against this by using rope having a generous factor of safety; that is, rope rated too large for the load put upon it.

The internal friction between fibres of ropes increases with the speed when running over pulley wheels. Heat caused by friction of rope rubbing against something also injures and weakens the rope. Small ropes become

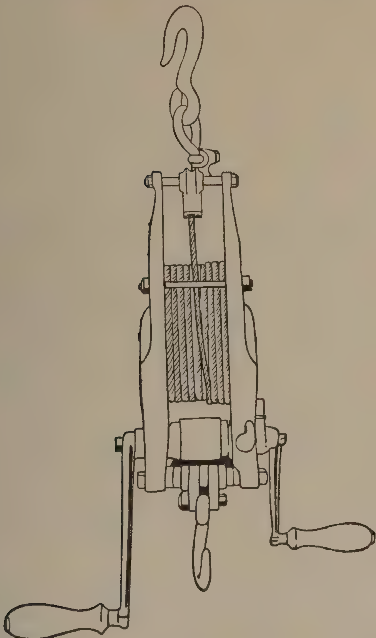


Plate 82.—Hoisting Machine

unsafe much more quickly than large ropes. It is not easy to detect weak places in ropes caused by excessive strain, decay or otherwise. Your only protection is to buy high quality ropes and then use and care for them in the best possible manner.

Hoisting Machines, Plate 82.—In this machine the

painter has one of the greatest improvements recorded in favor of swing stages. It not only makes this type of equipment much safer to use but also decreases the labor required by one-half or two-thirds. Hoisting machines using steel cable instead of ordinary rope are used by painters, bridge builders, building cleaners, ship yards and by others.

The hoist locks itself in position. It cannot let go or unreel the cable and cannot be unreeled until you turn the handles a little to raise the stage slightly and then raise the locking lever at the same time turning the handles backward. The brake then goes into action immediately. On leaving a stage at night the handles are removed and the machine is locked. The hoisting machine is used on swing stages and for boatswain's chair tackle used on steeples, chimneys and high columns.

The Use of Swing Stages.—The illustrations in Plates 76, 77, 78, 79, 83, 84, 85 and 86-A show better than words the manner in which swing stages are rigged. Study the illustrations as it is important that the tackle be correctly rigged. The place to begin when rigging a swing stage is to place the platform stage on the ground at the bottom of the first stretch of wall to be painted. Place the stirrups or bumpers under the platform and lay the single blocks on the platform under each stirrup.

Get out the coils of rope and carry them to the roof together with the cornice hooks and tie-back rope lines which should be at least one-half inch ropes.

Place the cornice hooks securely over the capstone of the brick wall or over the cornice. Securely fasten the ends of the tie-back ropes to the rings in the upper end of each cornice hook. Carry the tie-back ropes straight back and secure them to the base of a chimney, soil pipe or any securely attached projection. The purpose served by these tie-back ropes is simply one of

safety. They steady the hooks, and if the capstone or bricks should crumble or tear out of place by the load of the swing stage, the ropes will still hold the hooks in place to sustain their load.

The cornice hooks may now be lifted up to the roof again and the two double-pulley wheel blocks should be hooked into place; the hooks on the blocks go through the eyes on the lower ends of the cornice hooks.

Before lowering the cornice hooks into place again, bring the two single-wheel blocks up to the roof and proceed to rig the block and tackle outfit. Tie one end of the rope securely to the becket, which is the loop hole at the opposite end from the hook of the single wheel block. Put the other end of this rope through one pulley wheel of the double block. Carry the end down through the wheel of the single block; then up again and through the second pulley wheel of the double block; let the free end of the rope slide down over the cornice to the ground.

The next task is to get the single block down to the ground so you can hook it into the eye hole of the stirrup. This single block is not heavy enough to go down of its own weight, so it is necessary to hang a weight onto the hook—a bucket of sand or stones serves this purpose well. Of course, some one must hold the free end of the rope fall which you dropped over the side to the ground so the bucket and block will not go down with a rush.

Having the single block down and hooked onto the stirrup eye, place the cornice hook again firmly so it will rest on the top point where the tie-back rope is secured and on the lower end where the double block is hung. The arched center of the hook should have no bearing unless located as in Plate 83.

When both sets of blocks and hooks have been located and rigged, go down and pull at the free ends of both ropes to lift the stage platform two or three feet

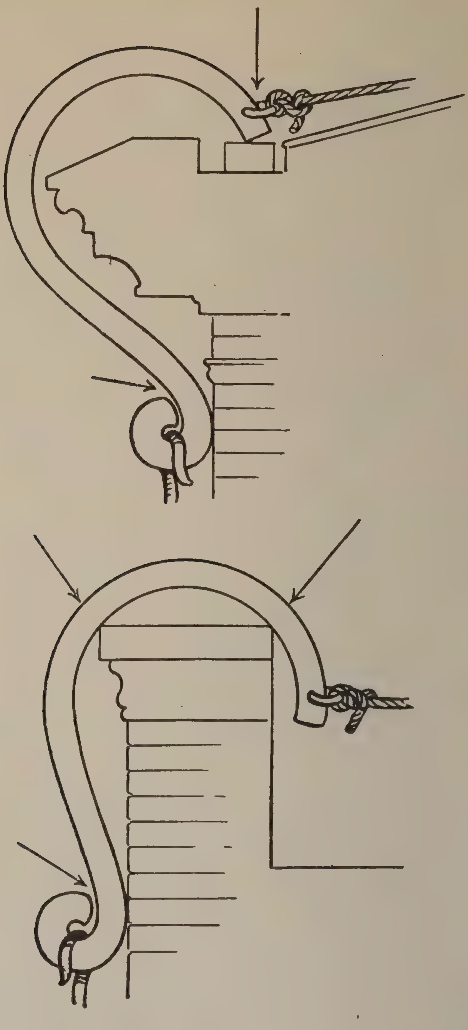


Plate 83.—Proper Placing of Cornice Hooks

off the ground and level for testing. The free end of the fall rope should be tied securely to the upper end of the metal stirrup rod, using a knot which is both secure and easily untied. Plate 86 illustrates various knots used for this and other scaffold rigging purposes.

Place on the scaffold the full load of men and materials and proceed to test it by springing it up and down. Then examine the cornice hooks and if all is secure you are ready to raise the stage to the top level and begin work.

Before going up place the guard rail in place in its iron supports which are a part of the metal stirrups.

There are a number of precautions which every prudent workman will observe when using swing stages. It is especially necessary for new men to observe these precautions.

The very first rule to observe is to be careful to keep a man's *weight on the outside of the stage and hands off the wall.* But a comparatively light push against the wall will swing the stage out and may throw one or more men off.

It is a good plan to have one man on the roof to observe the action of cornice hooks while the first test is made of the setting. Sometimes the hooks squirm around and need more secure footing. Keep in mind also that the strain pulls outward more as the stage is raised nearer the roof.

Cornice hooks ought never to be located with the upper sharp points resting on metal gutters;—a block of wood under each point makes a safer hold, but even then there is some doubt.

There are other ways to secure the upper tackle block to the roof or cornice, but none is so good as the use of cornice hooks. Some of the older painters simply throw the looped end of a double rope over the capstone of a brick wall or over a cornice as noted in Plate 84. The ends of the rope are carried back and secured

like a tie-back line to a chimney base or other projection. There is more risk in this proceeding than one should take, especially if a pad of carpet or a bag of sand are not used under the rope, where it turns sharply over the edge, to prevent the cutting of the rope. Nothing smaller than a new one-inch rope should be used for the tie-back, and the hook of the block should be secured

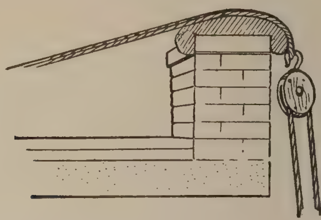


Plate 84.—The Rope Lookout

in the loop of the rope with an artificer's knot, similar to the clove hitch shown in Plate 86.

Another device used sometimes in the absence of roof cornice hooks is called a cantilever lookout. It, too, is dangerous. A plank is run out of a window two or three feet and a rope or metal band is used to attach the pulley block to the end of the plank, as in Plate 85.

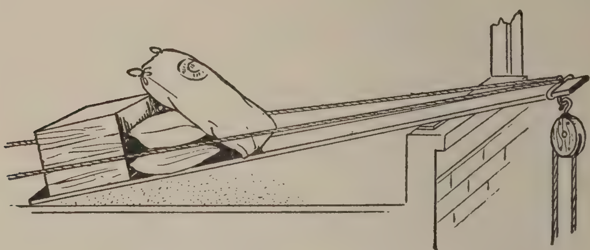


Plate 85.—Cantilever Lookout

If the plank is long and sound, if enough weight, in the form of boxes, barrels or bags, is put on the inside

end and if some one doesn't come along and remove the weight, the painters on the scaffold are fairly safe. But why gamble on so many risks when good cornice hooks eliminate them?

A real source of danger lies in the hitches necessary to hold the scaffold in position. Particular care should be taken to see that every man working on the scaffold understands fully the safest means of making the necessary hitches to insure the scaffold remaining in place. Carelessness on the part of one man handling the falls may result fatally not only to himself but others on the scaffold with him, and to people passing underneath, where the scaffold is swung over a sidewalk.

Rope, Knots and Hitches, Plate 86.—In former years it was more necessary to know all about knots and hitches, because ropes were more used in rigging scaf-

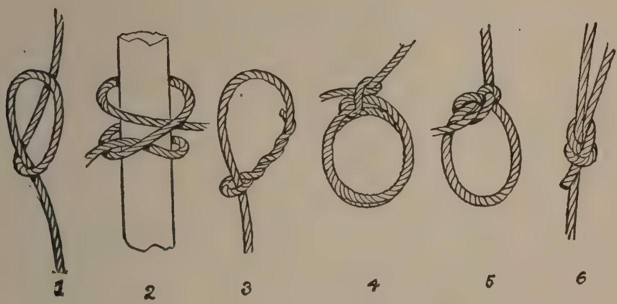


Plate 86.—Ropes, Knots and Hitches

folds than they are today. Now mechanical devices are performing these functions much better and safer.

Knowing some of the more common hitches and knots is still of considerable value to a painter. There are probably two dozen different hitches and knots in use, but the several shown on Plate 86 are sufficient, no doubt, for needs today.

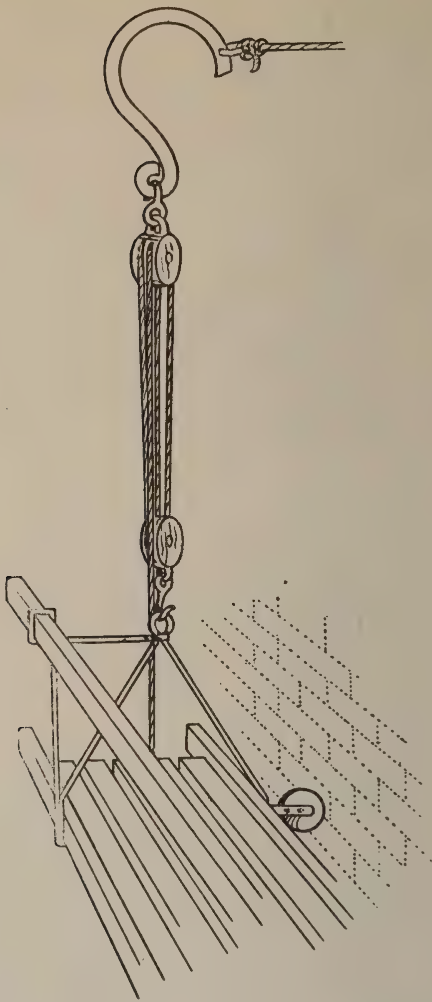


Plate 86-A.—Method of Rigging Fall Ropes for Swing Stage

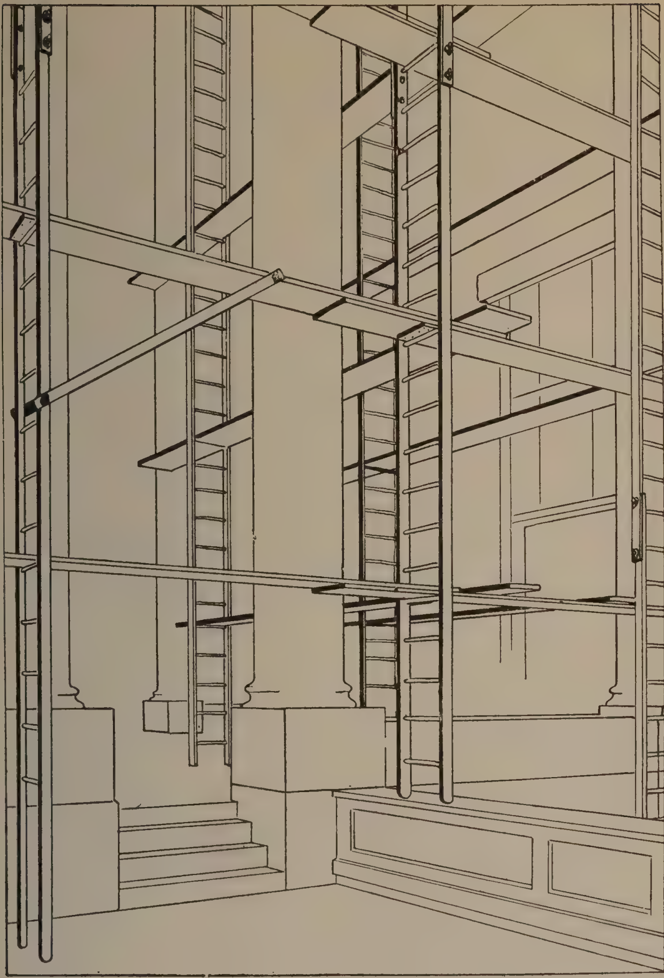


Plate 87.—Special Built-up Scaffold

The hitches and knots shown are: The backwall hitch used for making the loose rope fall fast to the lower hook; the clove hitch for making a loose rope end fast to a rail or turning a tight double strength eye in the bight or loop of a rope; the timber hitch used to make a rope end fast to a plank or timber being hoisted up or lowered from a roof; the square reef knot used for tying two rope ends together; the bowline used to make an eye loop which will not run; the round turn and two half-hitches for making a rope end fast to any part of an object with a large diameter like a barrel. All of these knots and hitches are easy to learn to tie and they will not jam tight under a load. A painter who knows how to tie all these knots and hitches is able to make himself useful for any scaffold work encountered.

Special and Built-up Scaffolds. Plates 87, 88 and 89.—There are various types of patented scaffolding in use which can be built up with ladders of common kinds and fastened with braces and irons with bolts to hold them in place. Plate 88 indicates one way in which this sort of scaffold can be built up. Wherever there are high porch columns, as on colonial homes and public buildings, and where there are interiors with very high ceilings, as in public buildings, this sort of scaffold is very useful. In some sections of the country there are firms which are organized for carrying on a scaffolding business. They erect and remove such scaffolding on a contract basis.

Plate 88 illustrates the common way of building up scaffolds with two-by-four and four-by-four and four-by-six timbers. Painters, interior decorators, carpenters and plasterers use this type of scaffold for interiors of churches, banks, theaters and other large interiors. The cost of such scaffolding is great, not only because of the large amount of lumber used, but because considerable labor is necessary.

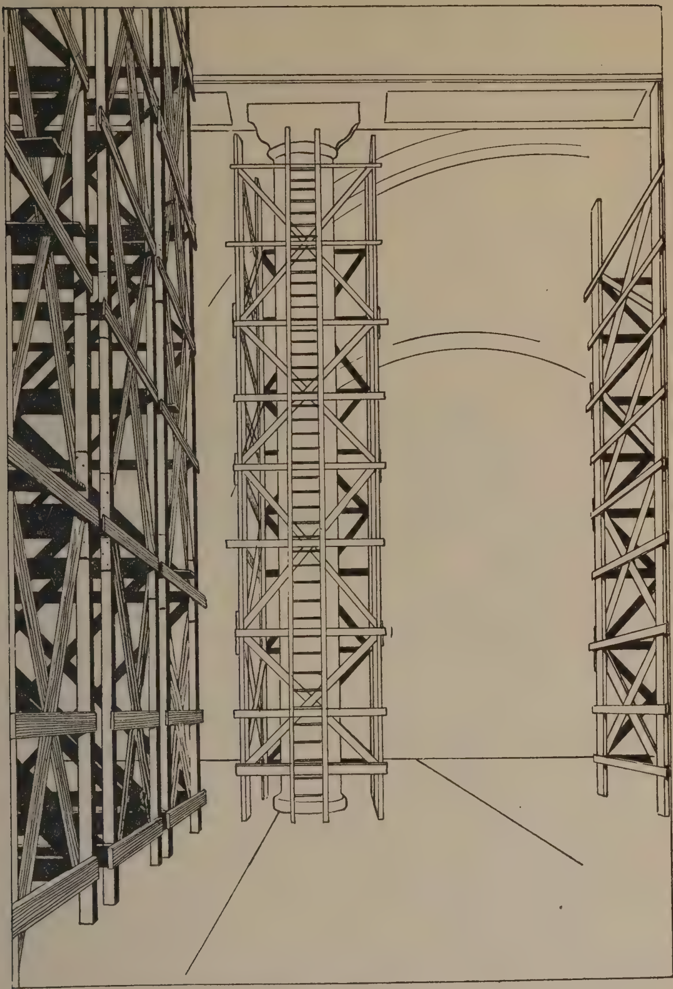


Plate 88.—Scaffold Built Up with Lumber

Large factory interiors with ceilings of moderate height are often spray painted without scaffold other than two saw horses mounted on truck casters, as indicated in Plate 89. Very rapid progress can be made by this simple arrangement when painting ceilings.

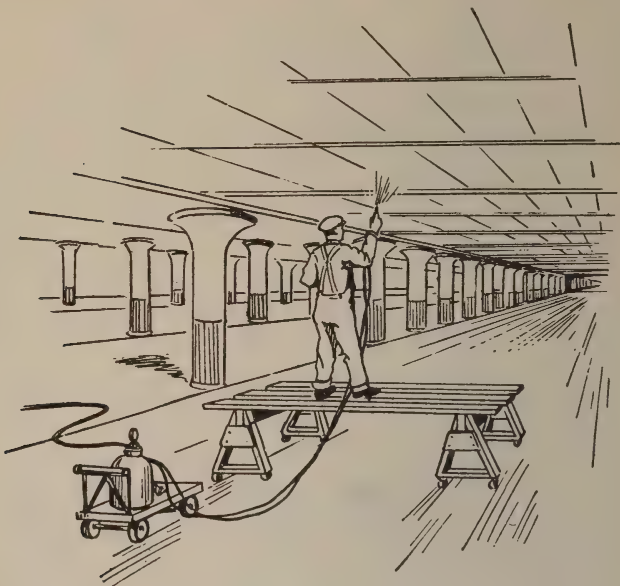


Plate 89.—Sawhorse Scaffold on Wheels for Spray Painting

CHAPTER V

MISCELLANEOUS PAINTERS' TOOLS

THE ability of any mechanic to do first class work and a reasonable amount of it every day depends upon his having good tools, upon his ability to keep those tools in first class condition and upon his inclination to care for his tools. The trade of painting and decorating has made considerable progress in the design and construction of tools during the past few years and it is to the advantage of every skilled worker to acquaint himself with improvements in tools as rapidly as they are made. One of the best ways to gain this knowledge is to cultivate the habit of reading the advertisements in trade papers and elsewhere. For the benefit of those who have not followed the development in improved tools, the author believes that it will be interesting to many to note the following descriptions of standard tools and of those which are of more recent invention.

Blow Torch Paint Burners, Plate 90.—The gasoline torch has, of course, been on the market for many years and the general appearance of all types is not much changed. There have been minor improvements, however, in the burner generating unit, which make some torches much more effective tools than others, because the flame is hotter and the better torches produce a steady flame without clogging and the consequent necessity for tinkering.

The common blow torch is filled with gasoline, preferably high test. It is pumped with just enough air to assure a steady flow of gasoline up through the

burner needle valve. Care should be taken to avoid putting in more air than is necessary. It is possible to put in so much air that the bottom will be blown out and the solder joints broken. Care should also be taken to avoid turning the valve wheel too tight. If this is done the valve seat will be injured and the torch will not work as efficiently thereafter.

To light the torch it is simply necessary to fill it with gasoline through the plug at the bottom, replace the plug in the opening and turn it fairly tight with the fingers or a short rod—do not use a wrench. As a rule about a dozen strokes of the pump handle will supply enough air. The valve is then opened a little by turning the valve wheel to the left until liquid gasoline flows out and fills the little cup under the

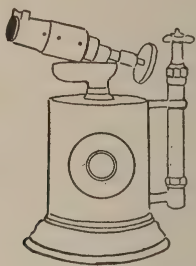


Plate 90.—Blow Torch Paint Burner

burner and generator. Light this gasoline with a match, place the burner in a location protected from the wind and allow the gasoline to burn out completely. Just before the last bit of gasoline has been consumed open the needle valve by turning the wheel to the left a little and the gasoline vapor which issues from the generator will take fire and burn rather unsteadily until all of the gasoline in the cup has been consumed and until the burner gets hot. The torch depends upon a hot burner to generate gas from the liquid gasoline

forced up through the needle valve by the air pressure. When the flame turns blue and ceases to flare up yellow you may open the needle valve a little more by turning the wheel to the left. The more you turn the valve open the hotter the flame will be.

The principal use to which the gasoline blow torch is put by painters is that of removing cracked and scaled paint from the outside of buildings. Occasionally, the blow torch is used on interior surfaces, but not often.

Acetylene Gas Paint Burners, Plate 91.—This is an improved tool used for the same purposes as the gasoline blow torch. The outfits consist simply of a steel tank loaded with gas, the same kind of tank as was originally used for automobile lighting and is still used for lights on automobile trucks. A long hose extends from the valve control on the top of the tank to a metal nozzle end having a wood handle. The flame at the nozzle of the burner may be regulated easily so as to produce a thin sheet of flame with a spread of 3 inches, or one of only about 1/8 of an inch. The flame can be accurately directed along a straight line when desired. The heat is very intense, much more so than can be secured from the ordinary type of paint burner. This type of burner weighs only 10 ounces; it can be lighted or relighted instantly without generating and so saves fuel and time.

The use of the burner is simple. It is necessary only to attach the hose to the tank, attach the metal burner to the other end of the hose, adjust the flame to the size wanted and then direct it on the surface. The burner is held in the left hand and a broad knife scraper is used with the right hand. The flame is held onto the paint and as the paint blisters up the flame is moved onto another spot while the blistered paint is scraped off with the scraper in the right hand. It is claimed that this type of paint burner saves about one

third of the cost of removing old paint. It saves both on fuel and labor.

When the tank is empty it can be returned to the

Plate 91.—Acetylene Gas Paint Burner

gas service station where a new tank will be supplied at the cost of the gas only.

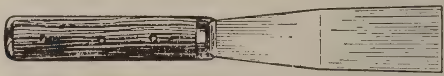


Plate 92.—Putty Knife

Putty Knives, Plate 92.—This tool is known to all mechanics and is used by painters and decorators for a great many purposes. Its original purpose was, of

course, that of placing putty into holes and cracks on surfaces and for placing the putty on the outside of window frames to hold the glass securely in place. Many styles of putty knives are made, but in general they are very much alike. Some blades are more flexible than others, some are made of better steel than others. Likewise there are differences in shapes and styles of handles depending upon the ideas of the many manufacturers of this tool. The putty knife is used to a large extent for scraping off paint, plaster accumulations, etc. Scraping knives which are much broader of blade are more effective when working on large surfaces.

Scraping or Stopping Knives, Plate 93.—This tool is

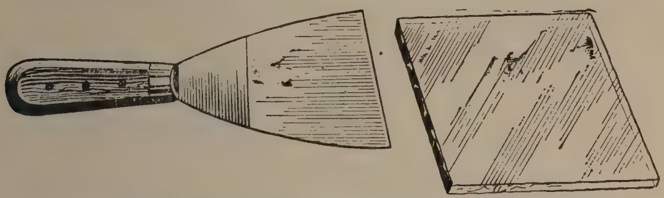


Plate 93.—Scraping or Stopping Knife and Glass

virtually the same as a putty knife except that the blade is wider and usually more flexible. While putty

Plate 94.—Rubbing Pad

knife blades are, as a rule, about $1\frac{1}{4}$ inches wide, stopping or scraping knives are made with blades from $2\frac{1}{2}$ to 4 inches wide. These knives are made for scraping off paint or other materials and for filling holes and cracks with putty.

Rubbing Pads, Plate 94.—This tool is used for rub-

bing enameled or varnished surfaces with fine pumice stone or rotten stone, using water or oil. The purpose of the rubbing is to remove the gloss and to produce a very smooth, satin-like finish. Pads are made up in many sizes, but the one shown is 2¼ inches wide and 6 inches long. A piece of thick felt fastened onto a wood block with tacks is often used for the same purpose.

Brush Extension Handle, Plate 95.—While working

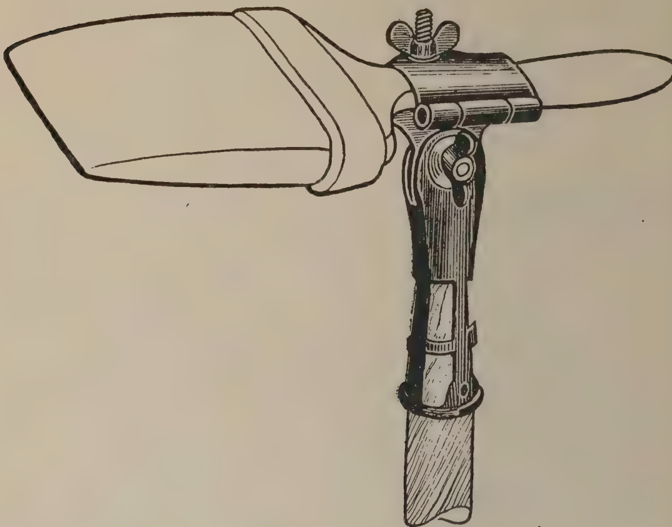


Plate 95.—Brush Extension Handle

in factory building interiors, and sometimes in office or store buildings, there are some surfaces which are very difficult to reach because of obstructions consisting of pipes usually. Such surfaces are often reached by using a long pole as an extension handle for a common brush. An extension handle is also handy for reaching high

places such as chimney stacks, flag poles, etc. The extension handle enables you to reach such surfaces without scaffolding.

Paint Strainers, Plate 96.—There are on the market

Plate 96.—Paint Strainers

various tools designed for straining of paint. The illustration shows the two types commonly sold. The one at the top and to the left is a paper strainer of cone shape and it is intended for use only once or twice. They cost little. The other strainer is made of tin and it is provided with a wire screen bottom which can be replaced with new taken out for cleaning and can be replaced with new

screen when needed. The painter, of course, commonly uses a piece of fly screen for straining paint and this is all right when used simply to aid the mixing operation. If the paint is rather clean to begin with and is being mixed for exterior surfaces, the fly screen strainer serves the purpose. However, when straining varnish, enamel or paint for fine interior surfaces, fly screen is not fine enough. A double thickness of cheese cloth when tied over the top of a clean paint bucket makes a much better strainer.

Paint Mills, Plate 97.—Years ago the paint mill was very essential equipment for every paint shop. Then it

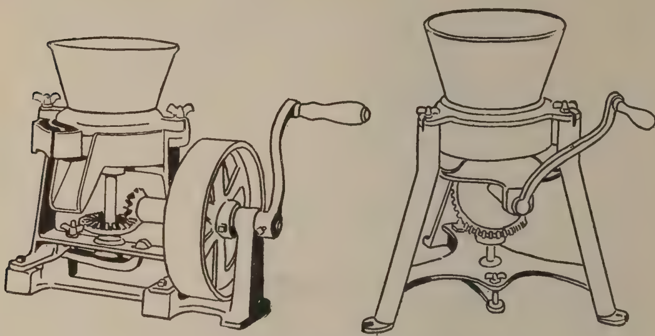
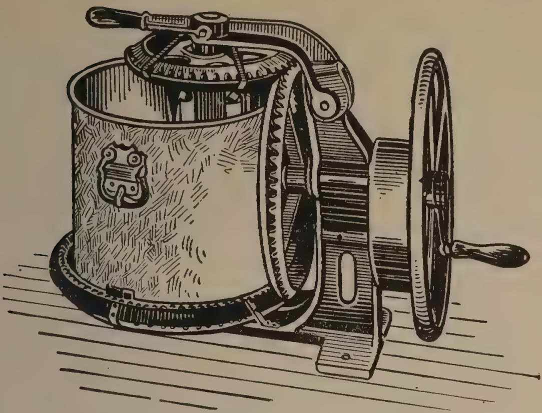


Plate 97.—Paint Mills for Grinding

was customary to buy dry white lead, dry colors and grind the dry pigments with oil by hand. That is a waste of time today and it is not possible to produce by that method paints and enamels which are equal to the high class manufactured products. The paint mill has but minor uses in the modern paint shop. The mixing of putty, fillers and grinding up old paint skins constitute the principal use to which the paint mills are put today. Paint mills are made in four sizes, from ¼-gallon to 3-gallon capacity; they are made to be



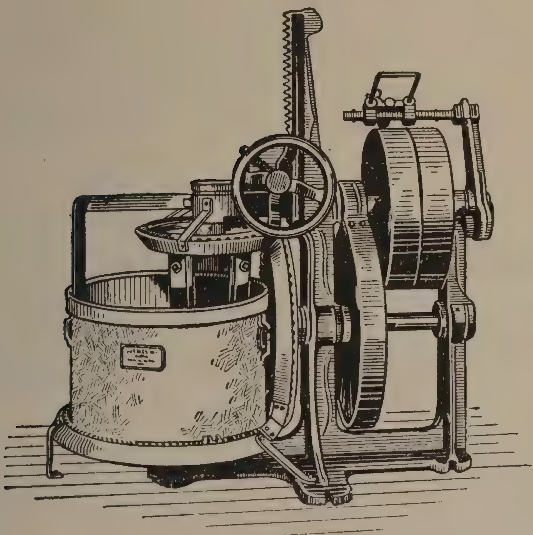


Plate 98.—Paint Mixing Machines

operated by hand or by belt power from an electric motor or gasoline engine.

Paint Mixing Machines, Plate 98.—The mixing of rather large batches of putty, floor fillers, paints and colors is most economically done by using paint mills of the same type as are used by manufacturers. Every well equipped paint shop should have at least a hand power paint mill and the mills which run by motor or engine using a belt easily pay for themselves in the larger shops by the time saved. Often the reclaiming of the small amounts of paint in the bottom of pots brought back from jobs will pay for a paint mill in a year's time. This reclaimed paint is run through the paint mills, being careful to keep the light and dark colors separate. With proper handling such paint is very useful for many purposes, especially for brick and other rough areas. Paint mixing machines do not grind the paint, they simply do a thorough job of mixing and break up the pigment much more effectively than can be done by hand. These machines are made in various sizes from 5-gallon capacity to many times that quantity. The machines are easily cleaned and the tanks may be lifted out of position quickly.

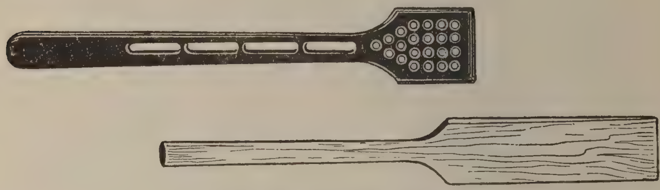


Plate 99.—Mixing Paddles

Mixing Paddles.—The paddle most commonly used, of course, is one which is made of wood and, as a matter of fact, most any kind of a stick is considered good enough. As a matter of fact, a paddle which is carefully made does the work more quickly. An ideal paddle is one which is shown in Plate 99 and one which is plenty

long enough to permit the use of both hands when large batches of paint are being mixed. The metal paint mixer is used to some extent and is effective.

Palette Mixing Knife, Plate 100.—This tool is used, as a rule, only in the shop for mixing small batches of

Plate 100.—Palette Mixing Knife

fine pigments or colors on a stone or glass mixing slab. With such a tool the mixing can be thoroughly done and color matches are easily made in this manner.

Pots and Tubs, Plate 101.—When mixing paint it is well to have a pot or tub which is at least twice as

Plate 101.—Pots and Tubs for Paint Mixing

large as is necessary to hold the quantity of paint being mixed. Empty barrels are used for large batches of paint, sometimes a barrel is sawed through the middle to make two mixing tubs. These are very handy for

use in the shop. Empty 100-lb. white lead kegs and also the 5-gallon size of prepared mixed paint containers make excellent mixing pots. The 1-gallon prepared paint pails and 25- and 50-lbs. white lead buckets are the best possible pots to carry around on the job.

Paint Agitator, Plate 102.—This is a tool of recent design and it is used for the rapid mixing of paints,

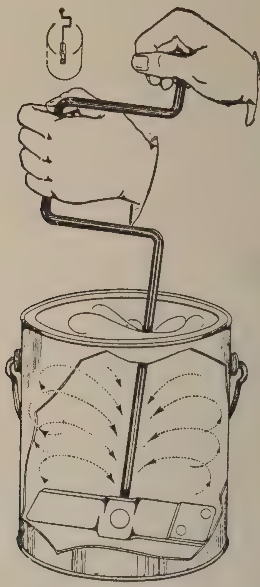


Plate 102.—Paint Agitator of a New Type

enamels and other materials as indicated by the illustration.

Wall Scraper.—For removing cracked, scaled and blistered paint and also old wallpaper this tool is an improvement over the small hand scrapers because the handles are made in lengths of from 9 inches to 28 inches, thus enabling one to use both hands in the work.

Where large surfaces are to be scraped a man can do more and better work using two hands.

Steel Wire Brushes, Plate 103.—These tools are made in various sizes and shapes with many grades of wire.

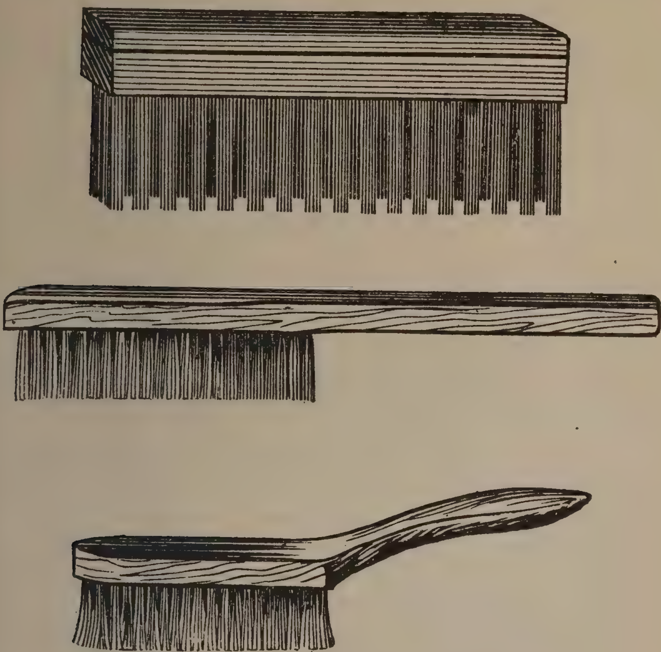


Plate 103.—Steel Wire Brushes for Cleaning

Some brushes have long flexible wire of considerable strength and thickness while others have short wire. Some brushes are made up with rather soft flexible wire also. We are illustrating the three types of brushes most commonly used by painters for removing scaled paint, rust and dirt on brick and metal surfaces. Some brushes cannot be used on wood surfaces because they will injure the wood by scratching.

Sand Bellows, Plate 104.—A tool which has been used to a greater extent in the past than the present. The purpose served by the sand bellows is that of blowing fine dry beach sand into wet paint. Such a treatment

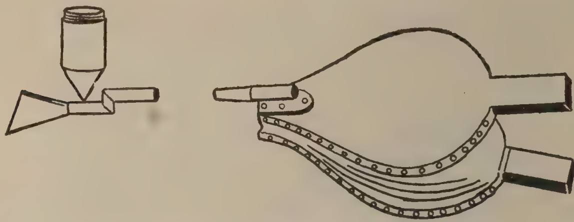


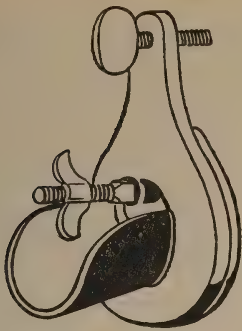
Plate 104.—Sand Bellows

of paint has been used more extensively on railroad stations than elsewhere to prevent the boys from cutting their initials in the wood with pocket knives. Paint loaded with sand in this manner is very apt to scale off and for that reason the sanding of paint is not done as much as formerly.

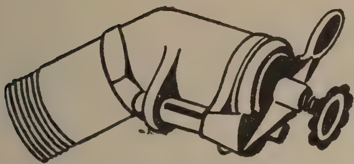
Bung Spouts, Gates and Faucets, Plate 105.—These devices are simple metal spouts to be attached to the hole in a barrel of oil, turpentine, benzine or varnish. They enable you to keep the hole closed and to drain out the barrel completely. They are made of metal and are easily attached and removed from barrels.

Moulding Scrapers, Plate 106.—For the removal of paint from curved mouldings these scrapers of various shapes prove to be handy, time saving tools. They are made of good steel, properly tempered and can be sharpened when necessary.

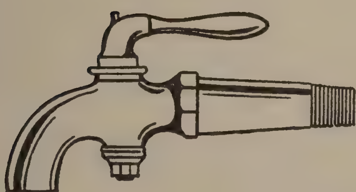
Ship Scrapers, Plate 107.—For the removal of heavy coats of paint, iron rust, etc., the large scraper used for scraping down the sides of ships is a handy tool which is being used in many places by painters. This scraper is 17 inches long and has a comfortable handle. The blade is $4\frac{1}{2}$ inches wide, bevelled and extra thick.



Bung Spout



Oil Gate



Benzine & Turpentine Faucet

Plate 105.—Bung Spout, Gate and Faucet

Glass Cutters, Plate 108.—The glass cutter is a tool known to every one. There are various styles of handles and sizes, all of which accomplish the same purpose with

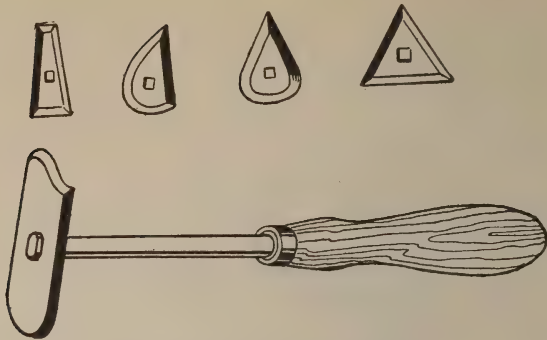


Plate 106.—Moulding Scraper

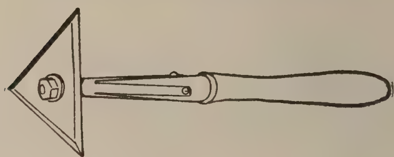


Plate 107.—Ship Scraper

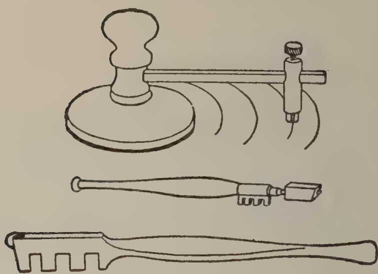


Plate 108.—Glass Cutters

more or less efficiency. The illustration shows a common type of cutter, the real diamond point cutter and the circle glass cutter. The effectiveness of a glass cutter depends to a large extent on holding the tool cor-

rectly in a vertical position and between the first two fingers, using the thumb to steady the tool.

Glass Pliers, Plate 109.—Where any considerable amount of glazing is done it is necessary to have glass

Plate 109.—Glass Pliers

pliers to handle the cut off edges of glass. They save time and make more certain of clean cut edges.

Glaziers' Hammers, Plate 110.—This tool is used for driving the little triangular glazing points into position

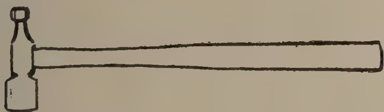


Plate 110.—Glaziers' Hammer

quickly without danger of breaking the glass.

Automatic Putty Guns, Plate 111.—When a great number of windows are to be glazed and puttied the putty gun shown in the illustration speeds up the work because it enables the glazier to run out just the right

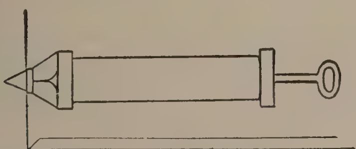


Plate 111.—Automatic Putty Gun

amount of putty and place it in the proper position. The putty gun holds a quantity of putty in good con-

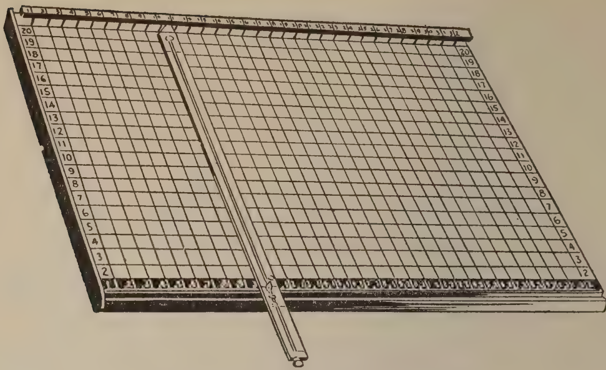


Plate 112.—Glass Cutting Board

dition for several days and it may also be used to drive the glazing points into position.

Glass Board, Plate 112.—A level board marked off in inch squares. The board is square and level. By using a "T" square you can be sure of cutting glass square on this board, or by using an ordinary rule and following the square lines of the board the cutting can be made with sufficient accuracy.

Glazier's "T" Square, Plate 113.—A tool similar to the "T" square used by mechanical draftsmen. It is

Plate 113.—Glaziers' "T" Square

used on a square glass board for a guide to be followed in cutting glass.

Glazier's "L" Square, Plate 114.—This is a tool used on a square glass board for cutting glass to true dimensions.

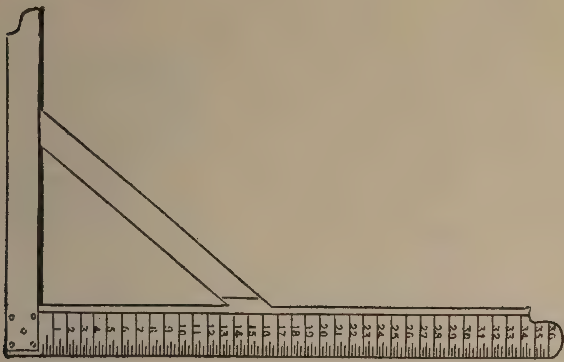


Plate 114.—Glaziers' "L" Square

Drop Cloths.—These are large pieces of light weight duck or canvas used to cover up floors, furniture, merchandise in stores and factories and cement sidewalks, etc. Any size can be secured but the sizes commonly carried in stock are 9x12, 12x12, 12x15, 14x16.

Electric Floor Surfacing Machines.—The painting and decorating industry needlessly expends a great deal of human energy doing by hand numerous tasks which can be done better, cheaper and with a saving of time by electric power.

Plate 115 illustrates two machines of the floor surfacing type which are operated by electric motor. The motor drives a revolving cylinder, or drum, covered with a large sheet of coarse or fine sandpaper. These machines are easily directed and controlled in any room. They quickly strip off old paint and varnish finishes. Furthermore, they grind down rough areas and high board edges, making a floor much superior to

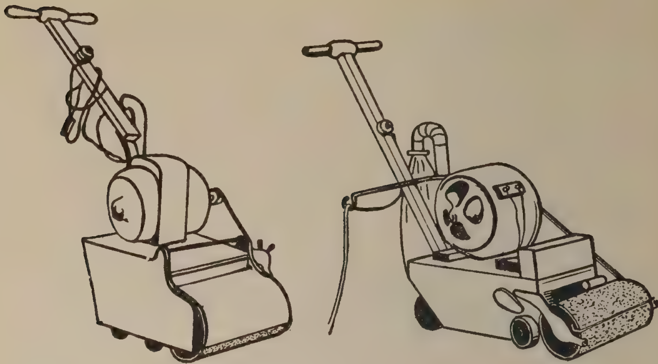


Plate 115.—Floor Surfacing Machines

the original hand scraped surface as to color and smoothness.

Plate 116 illustrates two machines which are useful to the painter and decorater in many ways. Various

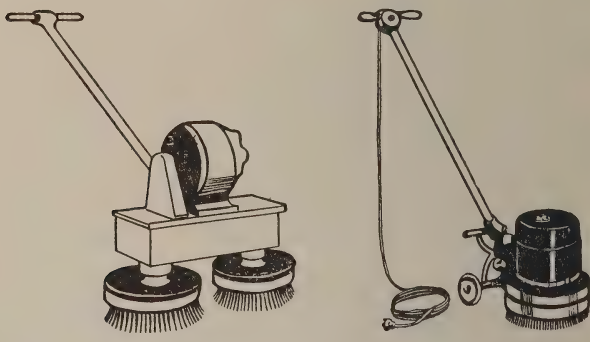


Plate 116.—Electric Floor Finishers

kinds of revolving tools are attached to these machines: —a fibre brush for scrubbing floors; a wax spreading brush; a wax polishing brush for floors, table tops and other polished surfaces; steel wire brushes for heavy

scrubbing of wood, marble, tile and terrazzo floors and for removing accumulations of grease, oil, dirt and old coats of paint, wax and varnish from any floor; a sandpapering disc to which fine sandpaper is attached for smooth finishing of floors; a polishing pad; a pumice pad of felt for removing stains and rubbing floors and furniture to a smooth and level surface; a carborundum disc for grinding down marble and terrazzo floors.

In this type of machines you have tireless workers which can be connected with any electric light socket and which will scrub, sandpaper, wax and polish.

Sandpaper.—Of the many grades of sandpaper on the market the common product is useful only for dry-sanding surfaces. There is no doubt, however, that the better grade of papers and those which can be used for wet rubbing with water, turpentine or oil are much to be preferred. They prepare a surface just as well and with some of the better papers much faster than dry sanding. At the same time they avoid raising dust which is so injurious to health.

The fineness or coarseness of sandpaper is rated as FF, F, 3/0 (or 000), 2/0 (or 00), 0, ½, 1, 1½, 2, 2½, 3, 3½, 4, 4½. No. FF is the finest and No. 4½ the coarsest.

Most of the sandpaper used by the house painter comes in sheets 9 x 11 inches or thereabouts. The finer grades used on automobiles, furniture finishing and on interior wood trim of houses is cut into small sheets about the right size to fit the hand. For the sanding of floors it is well to remember that large sheets of sandpaper can be secured for use on a board. A piece of plank about 10x18 inches having a broom handle secured to the center to work like a waxing brush and with a brick or two on top for weight saves a great deal of labor. A large sheet of sandpaper is secured to the board, being lapped over at both ends and fastened with thumb tacks. A brick or two may be placed on top for

extra weight. With such a tool floors are quickly surfaced without working on hands and knees. Note Plate 117.

A ream of sandpaper is 480 sheets of single-faced paper of any size, or 240 sheets of double-faced paper.

A quire of sandpaper is 24 sheets,—any size.

Sandpaper can be secured also in rolls 50 yards long and from 4 to 28 inches wide. Rolls are used chiefly in factory and millwork as belt sanders.

Steel Wool.—This abrasive is used for the same pur-

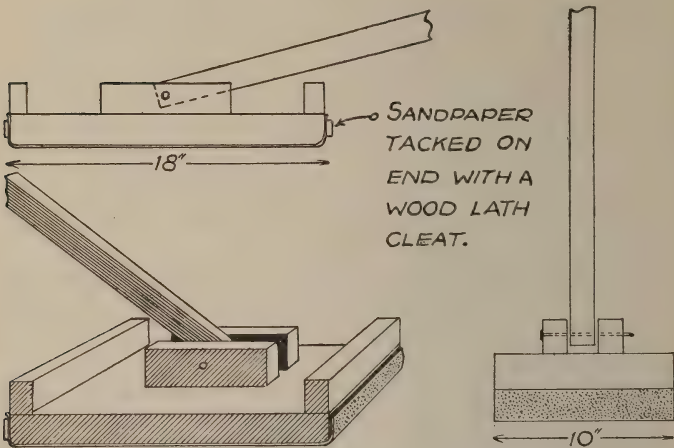


Plate 117.—Hand Made Floor Surfacer

poses as sandpaper and pumice stone. It is made in these grades.

No. 00,—equal to FF pumice stone
No. 0,—equal to F pumice stone
No. 1,—equal to No. 0 sandpaper
No. 2,—equal to No. 7 sandpaper
No. 3,—equal to Nos. 1½ and 2 sandpaper
Fine steel shavings

Medium steel shavings
Coarse steel shavings

Felt Rubbing Pads.—You can buy sheets of rubbing felt about 18 inches square or cut to any size desired and which is one-fourth or one-half inch thick. Two grades are sold—hard and soft. This felt can be cut up and secured to a wooden block of a convenient size to fit the hand. See Plate 94. The felt is cut about 1 inch longer than the block, the ends are curled up and tacked onto the ends of the block. There are various types of rubbing pads on the market which are convenient and which do effective work.

Sandpaper Holders, Plate 118.—Mechanics who are

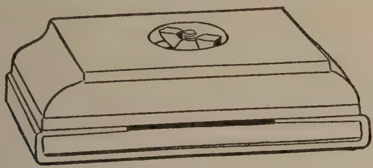


Plate 118.—Sandpaper Holder

very particular about having first class tools often prefer sandpaper holders which are made by manufacturers especially for this purpose. One type of holder is pictured in the illustration. A plain block of wood of a convenient size to fit the hand is often used for sandpapering and it will, of course, do a better job than when no block is used, because it exerts an even pressure on the paper and surface.

Pointing Trowels, Plate 119.—A tool preferred by

Plate 119.—Pointing Trowel

some painters for filling holes and large cracks in plaster walls. It is better than a putty knife or stopping knife for some fillings. The steel blade is 4 x 2⅛ inches.

CHAPTER VI

PAINTER-MIXED HOUSE PAINTS

ALTHOUGH there is a rather wide division of opinion among painters in their preferences for one kind of paint or another, it is the author's idea that when you eliminate personal preferences and prejudice there is often little choice to be made, based on facts, as between one kind of paint and another; that is, when the very best quality of each type of paint is considered. The author does not presume to advise painters to use one kind of paint or another. Each has its advantages and some disadvantages. Some painters prefer and use pure white lead paint mixed in their own shops and nothing else; some use only factory-made prepared paint and others are equally strong in their preference for shop-mixed paint, using white lead and zinc in combination, sometimes, with a moderate amount of inert pigments.

On one point it is suggested that you be very careful, that is, that while most brands of strictly pure white lead are equal in quality, from the standpoint of durability at least, the various brands of prepared or factory-mixed paint are far from equal to each other in durability, hiding or spreading qualities. When you compare the very highest quality of mixed paints, the best brands made by each of the leading and responsible manufacturers, with each other you are apt to have difficulty in choosing one paint in preference to others or in preference to shop-mixed white lead or white lead and zinc paint. When you compare the medium priced and low priced factory-made mixed paint, or so called

combination lead paints, with the best quality of prepared paint, or white lead paints, the differences are very marked as to hiding qualities, durability and the amount of surface covered per gallon. A great deal of the differences of opinion among painters as to the preference for one type of paint over another are possible only because of unfair comparisons, that is, by comparing cheap and medium grades of factory-made prepared paints with high grade prepared paint or shop-mixed white lead, or white lead and zinc paints.

To sum up, then, it is the author's idea that you can do first class jobs of painting with high quality paint of the white lead, white lead and zinc, or factory-made prepared paint, and that where your trouble begins is when you use cheaper brands of prepared paints or shop-mixed white lead paint which has been extended by mixing into it too large a percentage of zinc, silica, whiting, barytes, asbestine, etc. Unless a painter knows considerable about chemistry and the peculiar characteristics of paint pigments he is apt to run into trouble when he tries to mix paint which departs from a standard of pure white lead and linseed oil with from 10 per cent to 15 per cent of zinc oxide added. The other paint pigments have certain values, but unless used with exact knowledge and science they will make trouble. Titanium oxide is another basic paint pigment which is new and which is the subject of much experiment today. It is interesting because of its great capacity, but its merits have not been definitely proven as yet.

The subject of basic paint pigments, oils, thinners and driers is one which is very large, too large, in fact, to present in a thorough manner in this book. Full information concerning these paint ingredients is found in the author's book "The Mixing of Colors and Paints."

General Mixing Facts.—When either raw or boiled linseed oil is mixed with white lead the resulting paint

will have a gloss finish unless the surface is exceedingly dry and porous.

When turpentine, mineral spirits or benzine are mixed with white lead or other paint pigments, the resulting film will dry flat without any gloss.

When flatting oil is mixed with white lead or other paint pigments the paint film will dry flat or semi-flat, depending upon how much oil is in the pigment base. The film will have a slight sheen to it and will not be as nearly dead flat as when turpentine or benzine is the liquid.

When a varnish is mixed with white lead or other pigments you produce an enamel which will dry with a gloss unless you have used flat varnish, and in that event it will dry semi-flat.

Japan drier mixed with white lead or other paint pigments in the small quantities which are proper and in connection with raw linseed oil will not influence the film noticeably toward drying gloss or flat. If, however, a japan drier is used which has not sufficient strength, excessive quantities will be put into the paint and then the gloss will be increased. When mixing flat paints it is especially necessary to use the least possible amount of drier when it is necessary to use it at all. As a rule, drier is used only with raw linseed oil and it is used in greater amount with paint having rather large quantities of slow drying colors like lamp black and chrome green.

PURE WHITE LEAD

In this basic paint pigment we have one of the oldest materials and one which has been the mainstay of paints for over 200 years. Its virtues are many and for that reason practically all high class paints, whether made in a factory or in the painter's shop, contain a very large percentage of white lead. This is true, of course, only of white and light colored paints

used for exterior surfaces. The very dark browns, reds, and blacks may have no lead in them at all.

The distinguishing qualities of white lead are that it is the most opaque white pigment of proven durability for exterior surfaces. It hides the surface very well, works easily under the brush and is very stable chemically with linseed oil, turpentine, driers and most tinting colors. When a job of white lead painting wears out the surface is usually in perfect condition for repainting without any expensive burning and scraping off of cracked and scaled paint. Lithopone and titanium oxide are fully as opaque, but lithopone is used only for interior flat wall paints, enamel undercoaters, etc., and titanium oxide alone chalks off excessively when used for exterior surfaces. In combination with zinc it is much more serviceable.

White lead is made by treating lead metal with carbonic acid gas and acetic acid. This combination changes the lead metal to a soft white very fine powder. This dry lead powder is mixed with pure linseed oil in the proportion of about 8 per cent of oil to 92 per cent of lead to form the paste which the painter receives.

The one weakness of white lead as a paint is that white paint mixed from it and used on some surfaces under certain conditions may chalk off a bit too soon. This chalking or dusting off of the pigment is retarded considerably when colors are mixed with such paint, and chalking may be retarded in white paint by the addition of from 10 to 15 per cent zinc oxide to the lead. The zinc should be mixed only in the second and third coat, never in the prime coat.

A perfect paint, if there were such, would be a film of paint which was hard enough to avoid chalking excessively, or prematurely, and yet soft and elastic enough to avoid cracking and scaling. It is obvious that a paint which chalks is preferable to one which cracks and

scales. Chalking paint is a good foundation for new coats, whereas cracked and scaled paint usually must be removed by burning and scraping.

White lead is made by many manufacturers and by different processes for the control and speed of manufacture. All processes, of course, use the same elements —lead, metal, acetic acid and carbonic acid gas. The differences between the brands of white lead are not great and they consist principally of superior whiteness, fineness and hiding capacity.

MIXING METHODS FOR WHITE LEAD

White lead is marketed to the painter chiefly in the form of a thick paste made up of 8 per cent of pure raw linseed oil and 92 per cent of white lead. It may be purchased in tubes and in 1, 3 and 5 lb. press top cans; it is sold also in steel kegs which hold 12½, 25, 50 and 100 lbs. each net; it is, likewise, marketed in wood casks weighing 300 lbs. and 500 lbs. A 100-lb. keg of white lead bulks 2.85 gallons. Dry white lead is marketed but is not much used by the painter except for making putty. Most of the dry white lead marketed is sold to manufacturers of prepared paints.

The proper mixing of any paint has a much greater influence upon the success of that paint than is apparent on first thought. No matter how finely ground white lead, zinc or prepared paint may be from the factory process, they will not work as freely under the brush, spread as far, or hide the surface as well when carelessly mixed as when a careful job of mixing has been done. It is not more difficult to do a good job of mixing than a poor one. It is the method of procedure which counts the most. It is well to remember that lumps of paint can be broken up much more easily when only part of the oil or turpentine has been added than when all of the liquid is poured into the container with all of the pigment.

Breaking Up White Lead Paste.—If you are mixing only two or three gallons of paint, take an empty, clean 100-lb. white lead keg and place in it all of the white lead paste you will need for the batch. Next pour in only about a quart of linseed oil or turpentine. Stir the lead paste until all the liquid has been taken up by it. Now add another pint or quart of liquid and stir that in until it disappears. The time to do the most effective mixing is when you have put into a keg about one half of the oil needed. The paint in this state can be stirred readily and the lumps broken up, whereas if you added all the oil at once you would find lumps of pigment swimming around in the oil and dodging your paddle with the result that you would work harder, take a longer time and even then not do as good a job of mixing as if a small amount of oil is put in from time to time.

When about half of the oil has been mixed in add your turpentine and also the japan drier if raw oil is used.

The tinting colors, if any are to be used, should be mixed separately with oil or turpentine and may be added to the white lead paste before or after the final thinning with oil.

This procedure described for the mixing of white lead paste with liquids should be followed in the mixing of any paste with liquids—zinc, red lead, colors, etc. When it comes to mixing a dry pigment like dry white lead or zinc with liquids it is better to reverse the operation by putting part of the oil in the keg first and adding the dry pigment to the liquid, stirring the paint all the while.

Straining the Paint.—After the most thorough job of mixing has been done with white lead zinc or color pigments it will be found that if the mixture is allowed to stand over night or longer it will be thicker than when you finish the mixing and you can add more

liquid to it. Straining the paint is a considerable advantage whether paint is allowed to stand for some time, or whether it must be used immediately, because by straining you not only remove any skins, sediment, wood splinters or metal scales, but you break up the paint pigment into finer particles and incorporate the liquid more thoroughly. Straining enables you to add more liquid, it makes the paint brush out more freely and hides the surface better.

The straining operation is simple. If you are sure that the pigment is clean it is necessary only to strain it through fly screen. Paint used for finer interior jobs should be strained through a metal screen which is much finer than fly screen or through a single or double thickness of cheese cloth which has been tied over the top of the paint pot. The paint should have all of the liquid mixed into it before straining as it will then go through the strainer with greater freedom. It will take time to do a job of straining and painters who are young in experience are impatient about this work because it may seem to be useless. The time is well spent, however.

Adding Tinting Colors.—After your batch of white lead or other white pigments has been properly mixed with linseed oil and turpentine the tinting colors should be added. Use tinting colors ground in oil to paste form rather than dry colors, japan colors or distemper colors. The color paste should be mixed with a little linseed oil or turpentine in a clean pot and when thoroughly broken up the color should be strained into the white paint through cheese cloth, or fine metal screen. When tinting paint to match samples add your color cautiously. Each batch of color added to the white should be stirred thoroughly and the paint should be tested by brushing a little of it out on a board. The color of paint always looks darker in the pot than when brushed out. If you note little streaks of darker color when

the paint is brushed out, that is a sure sign that you have not mixed the color thoroughly into the white paint.

If you have added too much color to your white paint it will take considerably more white to lighten up the color, and when you get through you will have quite a little more paint than you need.

Dry colors are used by the painter mostly for the tinting of white in the mixing of calcimine and for tinting putty to the proper color to match woodwork. If it becomes necessary to use dry color for tinting paint in an emergency the dry color should be thoroughly rubbed out and mixed with a little oil on a board, stone or piece of glass using a flat wood paddle or putty knife to thoroughly work the oil into the color. Strain the color through a double thickness of cheese cloth to remove any grit or coarse color particles.

Quantities of Lead and Liquids Needed.—It is not possible to state an exact formula for mixing a gallon of paint which will be suitable for use on all kinds of surfaces, such as wood, plaster, brick, cement and metals.

It is obvious that some surfaces are more porous and absorbant than others,—that when mixing paint to be spread on to such dry and porous woods as white pine, cedar shingles, poplar and fir, your paint will require a larger proportion of oil than when you are mixing paint to be spread upon well filled surfaces like yellow pine or cypress, both of which have pores that are saturated with resin or other oil substances. When mixing paint for the latter group of woods, and for all non-porous surfaces, more turpentine and less oil are needed.

Another consideration which governs the proportions of oil and turpentine to be added to basic paint pigments, or color pigments, is that which concerns the amount of gloss wanted on the paint. For exterior surfaces, as a rule, the more gloss you can produce the

better, which means that you want to use as large a proportion of oil as possible.

When a semi-gloss or a dead flat finish is wanted for interior painting, it may be secured by using less oil and more turpentine, or by using what are called flatting oils in place of linseed oil. The flatting oils are useful for interior surfaces only.

The mixing formulas for white paint which follow at the end of this section give quantities of lead, oil, turpentine and drier needed for new and old exterior and interior surfaces. They are as accurate as they can be made for average conditions. The paint mixer must, however, size up the surface to be coated and mix his paint accordingly.

The best way to determine whether your paint is mixed too thick or too thin, is to dip a brush into it and spread a little of the paint onto the surface to be coated. If the surface is a very dark color, your paint must be mixed thicker, or stouter, than if you are painting on top of a white or light-colored surface. Dark colors may be mixed thinner and will ordinarily be brushed out to a greater extent than white paints, and still they will hide the surface well.

The condition of an old painted surface is a factor which will govern to some extent the amount of oil put into a new batch of paint to be used on such a surface. If the old paint is quite hard and the surface well filled, it will absorb less oil than if the old paint is chalking badly and, consequently, is quite porous.

Other points which should be kept in mind about the quantities of oil and turpentine needed in paint mixing are that you will find some slight variations in the thinning qualities of the different brands of linseed oil, depending upon what manufacturers made it and from which of the world's markets the flaxseed came. The white lead which has been mixed with part of the lin-

seed oil a day or two before the final thinning will be found to absorb more oil than when freshly mixed. In other words, you may mix a batch of lead paint today and thin it down to what seems to be the correct brushing consistency, but if you allow it to stand a day or so it will be too thick and you must add more oil.

Less turpentine than linseed oil is needed to thin 100 pounds of white lead to brushing consistency. For instance, 100 pounds of white lead mixed for new outside work will take up 3½ to 4 gallons of linseed oil and 1 gallon of turpentine before it is thin enough for a dry and porous surface, while the same amount of lead will take up only about 2½ or 3 gallons of turpentine to bring it to brushing consistency.

In the mixing formulas which follow, raw linseed oil is specified. When a brand of high-class boiled linseed oil can be secured it is better to substitute boiled oil for raw in all these formulas and eliminate the drier.

The modern thought concerning the best quantities of oil and turpentine to use with white lead was well expressed by Robert L. Hallett, chemist for the National Lead Company, as follows:

"A slight reduction of the oil in the paint produces a paint film which still has a very satisfactory gloss, has even greater durability and is sufficiently hard to prevent the adherence of the dirt which is blown against it, although still elastic enough to prevent cracking and scaling. By hardening the paint film in this way a remarkable improvement in permanent appearance is secured without any detriment to the paint in durability or working qualities or any of the other characteristics. A reduction in the oil results in paint having greater hiding power, which is a marked advantage, and the permanent good appearance and freedom from discoloration have proven a great satisfaction to those who have adopted this practice. If the oil reduc-

tion produces a paint which is too thick to be readily applied with a brush, a slight amount of turpentine may be added to take the place of the oil and give any desired consistency.

"This discussion does not so much refer to the priming coat applied on new lumber, concrete, brick or stucco, because the priming coat must be so designed as to have sufficient oil to fill the pores of the material which is to be painted and furnish a firm foundation for the subsequent coats.

"The oil reduction begins with the body coat, which must be fairly hard to furnish a firm support for the finishing coat. Long experience has shown that paste white lead should be reduced with a mixture of about half oil and half turpentine for the body coat to give the best results.

"Perhaps the greatest difference of opinion is in connection with the finishing coat, where we find painters using all the way from three to five gallons of linseed oil to 100 pounds of paste white lead. Five gallons of linseed oil, or even four gallons of linseed oil, is an excessive amount, and, while the preliminary gloss obtained with such paint may be fairly high, the gloss is lost within a comparatively short time and the paint is so soft that it may become discolored by dirt blown against it. If the amount of the oil is reduced to three and a half gallons, three and a quarter gallons or, in exceptional cases, even three gallons to 100 pounds of paste white lead, the results are markedly improved, and it has been the universal experience that painters who have conscientiously tried out this practice have been well pleased with it and it has been a great satisfaction to them to realize that one more bit of knowledge has been added to paint technology and the master painter has been given the means whereby he can readily correct the dirt discoloration which he may have encountered in some places.

"It is sometimes difficult to make sure that the man who actually mixes the paint follows any definite formula, because necessary measuring containers are not always available when they are needed. There is a very simple method of overcoming this practical difficulty, which is to reduce the paste white lead for the body coat with a mixture of half oil and half turpentine, and reduce the paste white lead for the finishing coat with a mixture of linseed oil to which turpentine has been added at the ratio of from one to two pints to each three gallons of linseed oil. If this practice is followed the desired formulas are more or less automatically secured, because when this thinner mixture is used for reducing the paste white lead it will not be possible to add an excess of oil without obtaining paint which is too thin to be of brushing consistency. It has been found that white lead paint containing these smaller proportions of linseed oil is not lacking in durability, and while the original gloss may not be quite as high as when more oil is used, the gloss will last longer and the paint will have better appearance and give greater satisfaction throughout a reasonable lifetime. We know that a coat of linseed oil is not very durable in itself, and when exposed to the weather becomes destroyed within a comparatively short time.

"The white lead pigment itself is, of course, not a paint, but we realize that a mixture of white lead pigment and linseed oil together form a very much more durable coating than either the oil or the pigment alone; in other words, it requires the oil or binder to cement the particles of pigment together and produce a paint film, but it also requires the particles of pigment to increase the weather resistance of the paint film and give greater durability. The only question which can arise is, therefore, what is the optimum mixture of linseed oil and white lead which will give the greatest durability and best results."

STANDARD FORMULAS FOR WHITE PAINT

NEW OUTSIDE WOODWORK

First Coat

100 lbs. pure white lead
4 gal. pure raw linseed oil
1 gal. pure turpentine
1 pt. japan drier
Makes about 7¾ gal. of paint

Second Coat

100 lbs. pure white lead
1½ gal. pure raw linseed oil
1½ gal. pure turpentine
1 pt. japan drier
Makes about 6 gal. of paint

Third Coat

100 lbs. white lead
3½ to 4½ gal. pure raw linseed oil
1 pt. pure turpentine
1 pt. japan drier
Makes 6½ to 7½ gal. of paint

On the sea coast, where paint is subjected to salt air and hard, driving rains, some painters add from 10 to 15 per cent of zinc oxide to the last coat only.

OLD OUTSIDE WOODWORK

First Coat

100 lbs. pure white lead
2 gal. pure raw linseed oil
2 gal. pure turpentine
1 pt. japan drier
Makes about 7 gal. of paint

Second Coat

100 lbs. pure white lead
3 gal. pure raw linseed oil
½ gal. pure turpentine
1 pt. japan drier
Makes about 6½ gal. of paint

Third Coat

100 lbs. pure white lead
3½ to 4½ gal. pure raw linseed oil
1 pt. pure turpentine
1 pt. japan drier
Makes 6½ to 7½ gal. of paint

For two-coat jobs simply omit the second coat above. On weather-beaten and very dry surfaces use more oil and less turpentine in the first coat.

BRICK, STUCCO, CONCRETE SURFACES

First Coat

100 lbs. white lead
4 gal. pure boiled linseed oil
1 gal. turpentine
Makes about 7¾ gal. of paint

Second Coat

100 lbs. white lead
4 gal. pure boiled linseed oil
1 gal. turpentine
Makes about 6¾ gal. of paint

Third Coat

Same as for new outside woodwork.

Before painting new plaster or cement walls which have not been allowed to age more than 30 days, the causticity of the surface should be neutralized, or it may burn out the life of the oil in spots. Active alkali

spots will change the color of some paints, notably tints and shades mixed from chrome yellow. A wash composed of four pounds of zinc sulphate crystals dissolved in one gallon of water should be brushed onto this surface. When the surface is dry brush off any loose particles with a broom before painting.

Extra Drier Needed.—Under certain weather conditions—on cold, damp winter days and during humid days in the middle of the summer—it is sometimes difficult to mix your paint so that it will dry as rapidly as it should. During such weather additional japan drier to the extent of about ¼ to ½ pint should be added to 100 pounds of lead when raw oil is used. It is not often necessary to add any drier to boiled linseed oil, but there are some extreme conditions where a little is needed. During difficult drying weather a little extra turpentine will accelerate the drying.

When using slow drying color pigments such as lampblack, chrome yellow, chrome green and ordinary yellow ochre in considerable quantities to make dark-colored paints, additional turpentine and drier are needed.

How Much Paint from a Mix?—In order to determine the number of gallons of paint which you will have as a result of mixing white pigment, color pigment and liquids together calculate with the following facts. It is necessary only to add together the bulking values of each ingredient.

One hundred pounds of white lead in paste form, as it comes to the painters, bulks approximately 2.85 gallons, which is a little more than 2¾ gallons. Therefore, if in the mixing of 100 pounds of lead you use 4 gallons of linseed oil, 1 gallon of turpentine, 1 pint of japan drier, you will have a bulk of approximately 8 gallons of white paint. The amount of tinting color added usually is not enough to materially increase the amount of paint, although if the color mixed is quite

dark you must take into consideration the bulk of the tinting color too. The following tabulation will be of assistance to you in calculating the amount of material mixed from a batch of paint:

COLOR	Per cent of pigment in paste	Per cent of oil in paste	Bulking values in gallons
Venetian Red (40% FeO).	78	22	5.9
Indian Red	78	22	4.7
Ochre	70	30	6.8
Raw Sienna	55	45	7.8
Burnt Sienna	55	45	7.5
Raw Umber	54	46	8.3
Burnt Umber	54	46	7.6
Metallic Brown	75	25	5.9
Pure Para Red	30	70	11.3
Ultramarine Blue	65	35	7.8
Prussian Blue	43	57	10.1
Carbon Black	20	80	11.6
Drop Black	50	50	8.7
C. P. Green (average)	77	23	5.0
C. P. Yellow (average) ...	80	20	4.2
20% Green (Barytes base)	88	12	3.9
20% Yellow (Barytes base)	85	15	4.1
10% Para Red (Lime and Barytes base)	82	18	6.0
Red Lead	94	6	2.13
Lithopone	80	20	4.8
Basic Sulphate White Lead	91	9	2.86
Basic Carbonate White Lead	92	8	2.85
Zinc Oxide	82	18	4.05
Titanium Pigment BXX ..	80	20	4.6

The Amount of Paint in Pounds.—In calculating the weight of the paint in pounds you must follow the same procedure by simply adding to 100 pounds of

white lead the number of pounds of oil, turpentine and color mixed into the batch. A gallon of linseed oil weighs approximately 7¾ lbs.; a gallon of turpentine weighs approximately 6¾ pounds. A gallon of japan drier will vary considerably depending upon the composition of the drier. When you have added all these weights together divide the result by the number of gallons produced and you will have the weight per gallon. White lead paint, as a rule, weighs from 20 to 22 pounds per gallon. Prepared paints weigh from 14 to 15 pounds per gallon. The weight per gallon of paint, however, is not necessarily an indication of its quality.

ZINC OXIDE

From zinc ore mined in America, Europe and the Orient zinc metal is smelted. Although zinc oxide, the white paint pigment, is of modern origin, zinc metal is very ancient; the Chinese smelted ores and made zinc metal slabs 2000 years ago.

Zinc oxide paint pigment is made by two processes; one, the French, or indirect method, converts zinc ore into zinc metal by smelting and then converts zinc metal into zinc oxide by combustion. The zinc metal is melted in a crucible and as the heat is continued a vapor is drawn off through long flues. When this vapor comes in contact with more air it flames up and forms a very fine white powder—zinc oxide—which is collected in cloth sacks of special construction. This powder after being graded by fine screens is mixed with linseed oil and the paste is ready for the painter.

The American process for producing zinc is the same in principle but differs in method of application. The zinc ore is burned directly without first smelting it into zinc metal. The ore is mixed with fine coal and

burned in furnaces. A great deal more zinc is made by the American process than by the French process.

Zinc oxide is a combination of one atom of zinc metal with one atom of oxygen. Zinc oxide has been considered the finest in texture of all white pigments and the best qualities of zinc are the whitest of all white paint pigments.

This pigment, being so very fine in texture, is also very bulky. One pound of dry zinc fills a space about three times larger than is filled by a pound of dry white lead. The consequence of this great fineness and bulk is that zinc oxide absorbs more oil than white lead when it is mixed to brushing consistency.

Usually zinc oxide is ground with linseed oil in the proportion of from 15 per cent to 19 per cent of oil to 85 per cent or 81 per cent of pigment; while white lead is ground in the proportion of 8 per cent of linseed oil to 92 per cent of pigment.

One hundred pounds of zinc oxide paste bulks 4⅛ gallons; while one hundred pounds of white lead bulks 2.85 gallons—or a little more than 2¾ gallons.

These differences in proportions of oil and pigments and in bulk values must be kept in mind when mixing paints and enamels using these pigments. More oil is needed to thin 100 lbs. of zinc to brushing consistency than is needed to reduce 100 lbs. of white lead to the same brushing consistency.

And again, because of these differences you cannot, for instance, mix a paint in the proportion of 20 per cent zinc to 80 per cent white lead by mixing 20 pounds of zinc oxide with 80 pounds of white lead paste. To mix paint having a pigment content of 20 per cent zinc and 80 per cent white lead, you must mix together 22 pounds of zinc and 78 pounds of white lead. The following table will serve you as a ready reference

for mixing the correct proportions of lead and zinc:

PROPORTION WANTED

Zinc Oxide	White Lead	Use Zinc Oxide	Use White Lead
5%	95%	6 lbs.	94 lbs.
10%	90%	11 lbs.	89 lbs.
15%	85%	17 lbs.	83 lbs.
20%	80%	22 lbs.	78 lbs.
25%	75%	27 lbs.	73 lbs.
30%	70%	33 lbs.	67 lbs.
35%	65%	38 lbs.	62 lbs.
40%	60%	43 lbs.	57 lbs.
45%	55%	48 lbs.	52 lbs.
50%	50%	53 lbs.	47 lbs.
55%	45%	58 lbs.	42 lbs.
60%	40%	63 lbs.	37 lbs.
65%	35%	68 lbs.	32 lbs.
70%	30%	73 lbs.	27 lbs.
75%	25%	77 lbs.	23 lbs.
80%	20%	82 lbs.	18 lbs.
85%	15%	87 lbs.	13 lbs.
90%	10%	91 lbs.	9 lbs.
95%	5%	96 lbs.	4 lbs.

Use zinc oxide ground in oil paste and white lead ground in oil paste, to make these batches of 100 lbs. of mixed pastes.

Zinc oxide is a harder white pigment than white lead. Along with its many virtues, zinc possesses one defect considered as a paint pigment,—it is rather too hard and inelastic to be used alone with linseed oil as an exterior paint. It is too hard and brittle to expand and contract sufficiently with the wood or other surfaces during temperature changes. Such paint would crack and scale off, but when mixed with lead in the correct proportions, zinc makes good paint. Its hardness is balanced by the softness of the lead and the de-

fect of lead—being too soft—is balanced by the merit of zinc.

Zinc is chemically stable and mixable with other pigments, oils and colors. It is not affected by gases in the air.

Zinc is used, as such, by painters principally for enamels and enamel undercoatings where it produces a fine, hard surface. It is also mixed with white lead in the proportions of 15 per cent to 20 per cent in the finishing coat only for making a harder wearing surface on exterior white paints to overcome excessive chalking.

The best method for use in breaking-up and mixing zinc paste with oil is that described in this chapter for breaking-up white lead.

When mixing lead and zinc, break up your two pigments separately reducing each to brushing consistency with linseed oil, then pour one batch of paint into the other. Pour the paint mixture back and forth from one pot to the other several times and stir well with a mixing paddle to assure thorough mixing.

Necessary turpentine and japan drier may now be mixed into the paint. Tinting colors in oil paste form should be thinned enough to break up the lumps before being mixed into the paint. Then when all ingredients have been mixed together stir the paint well and strain it as described in this chapter for white lead paint and for the same reasons.

Use of zinc for interior paints may be made without thought of durability as to cracking and scaling. For enamels, enamel undercoaters and wall paints, zinc may be freely used wherever its virtues are needed. Good painters commonly agree that for exterior white paint, and in the last coat only, from 15 per cent to 20 per cent of zinc with 85 per cent or 80 per cent of lead makes the best proportions to overcome any tendency of the lead to chalk off.

Zinc is marketed in 12½, 25, 50 and 100 pound steel kegs and in tubes for artists and decorators.

Floor Paints.—Porch floors exposed to the weather are usually painted for protection and to improve appearances. A serviceable job of floor painting begins before the painter is called to the job. In the first place, construction of the floor should be such as will allow ample ventilation, at least one hole should be placed so the moisture from the ground can escape. This isn't necessary, of course, when the area under the porch opens into a warm basement.

One quality which floor paints must possess is the ability to dry hard and form a tough coating. The grinding wear of heels and furniture soon destroys soft paints, yet if the paint is too hard and brittle it will crack and scale off. There are on the market a number of brands of factory-made prepared floor paints which give good service. In using them it is simply necessary to mix these paints thoroughly according to manufacturers' directions.

When floor paint is to be mixed by the painter, his proportions using white lead and zinc are as follows for new floors which are usually yellow pine well filled with sap:

First Coat

25 lbs. white lead
7½ pts. turpentine
2½ pts. boiled linseed oil
Tinting colors
Makes about 2 gal. of paint

Second Coat

18¾ lbs. white lead
6¼ lbs. zinc oxide
¾ gal. turpentine
Tinting colors
Makes about 1½ gal. of paint

Representing the proportion of ¾ lead and ¼ zinc approximately

Third Coat

18¾ lbs. white lead
6¼ lbs. zinc oxide
3 qts. boiled linseed oil
1 qt. floor or spar varnish
½ pt. turpentine
Tinting colors

Mix the varnish and turpentine together before adding to the paint.

Makes about 1¾ gal. of paint

For repainting old exterior porch floors use only the second and third coats as specified for new floors. The cracks should be cleaned out first and filled with putty made with white lead, dry whiting and linseed oil.

In the mixing of floor paints your aim should be that of producing a paint film which will dry hard—a tough film into which dirt will not lodge, one which can be washed clean and one which will withstand the grinding wear of many feet and the scraping of furniture.

Enclosed porch floors ought, of course, to be painted like any interior floors. The first and second coats specified for new exterior floors are suitable for new interior floors. The third coat should be clear floor varnish which when dry may be waxed and polished. Old interior floors may well receive the second coat as specified for exterior floors, a clear varnish coat and the wax which may be polished.

Mixing Putty.—A great deal of the putty sold as commercial grade material is not good for painters' needs. Much of such material is marble dust and mineral or fish oil, making a putty too brittle to remain long where you put it.

The best putty for exterior surfaces is made by mixing dry bolted whiting with white lead in oil paste.

Add dry color to tint it to the color wanted. Small amounts may be mixed and kneaded by hand. Large batches may be placed on a stone mixing slab or board and pounded with a mallet or a club. When the putty gets too stiff a very little linseed oil may be added. If a little varnish—spar or floor—is added the putty will dry even harder. Lead and whiting putty will stick tightly where you put it and is good for all manner of exterior work on wood and for setting glass into windows and doors. A coat of paint should always be put on before the putty.

For setting glass in steel sash the best putty may be made from dry red lead, white lead in oil paste and dry litharge, using a little linseed oil for a binder.

Mixing Whitewash.—Whitewash deserves a more extensive use than it enjoys at present because it is an inexpensive, sanitary and light reflecting paint. For some purposes it is even better than other paints. Painters can find much employment coating basement interiors, stables and other buildings with whitewash when the weather prevents outside painting. In warm and dry climates whitewash coatings are also used on exterior surfaces to some extent. It may be used on wood, brick, plaster or stone surfaces.

There are many formulas for mixing whitewash. Some are better than others for some purposes. The following formulas will serve every purpose.

Interior Whitewash

1 bushel (62 lbs.) lime in lump form unslaked—quicklime. Air-slaked lime is not as good.

15 gallons water. Put in a barrel with the lime and stir occasionally to prevent scorching.

2½ pounds rye flour. Mix the flour with ½ gallon of cold water, then add 2 gallons of boiling water.

2½ pounds rock salt. Dissolve the salt in 2½ gallons of hot water.

Mix the flour paste with the salt water solution and then add the mixture to the lime and water in the barrel. Let stand over night and strain. The above whitewash is much used in factory buildings, warehouses, etc.

Exterior Whitewash
(Weatherproof)

1 bushel (62 lbs.) lime lumps (quicklime).

12 gallons of water. Put lime and water in a barrel and cover top of barrel.

2 pounds table salt and 1 pound dry sulphate of zinc. Dissolve the salt and zinc in 2 gallons of boiling water.

2 gallons skimmed milk.

Mix the salt solution into the lime and water, then add the milk and stir the whole batch well. Let the mixture stand over night if possible and strain it through fly screen before applying to a surface with a wide brush or a spray gun.

½ bushel lump lime slaked in boiling hot water, keep covered to retain steam. Air slaked lime is not as good.

Common practice is to add cold water a little at a time until lime crumbles up into a soft paste. Then stir and add more water until the lime cools down indicating that it will absorb no more water—it is completely slaked. Hot water hastens this process.

Next thin with water to brushing consistency and strain to remove lumps and dirt.

1 peck of salt—(15 lbs.) which has been dissolved in hot water.

3 pounds rice boiled in water to a thin paste; strain it and add to the lime and salt mixture while hot.

1 lb. of good glue soaked in cold water over night. Pour off excess water and add 3 quarts of boiling water and stir well. Then add ½ pound of dry whiting to the glue. Now add this glue and whiting mixture to the lime, salt and rice mixture. Add about 5 gallons

of hot water and stir the whitewash well, cover up and let stand a few days. Apply the whitewash hot for best results with a wide brush or spray gun.

Lighthouse Whitewash

1 bushel (62 lbs.) quicklime lumps
12 gallons hot water
12 pounds rock salt dissolved in 6 gallons of water
6 pounds Portland cement

Mix the lime and water in a barrel and stir until the lumps are broken up and the mixture is cool. Add the salt solution, then add the cement.

To prevent whitewash from rubbing or dusting off add one ounce of alum to each gallon of whitewash. The flour paste in the above formulas serves the same purpose but a little sulphate of zinc is necessary to preserve the flour from decay.

Some people like to add 1 pint of molasses to 5 gallons of whitewash, believing that the lime is then more soluble and that such whitewash anchors more firmly to the surface.

When silicate of soda (35 degrees Baume) water is added to whitewash in the proportion of 1 pound of soda to 10 pounds of whitewash a fireproof coating is obtained.

A gloss surface may be put onto a whitewash coating by mixing with the whitewash 1 pound of yellow laundry soap.

When a damp basement or other damp interior is to be whitewashed the formulas containing glue, flour or milk are not as good as whitewash made without these ingredients. Such organic matter may decompose, discoloring the surface and perhaps giving off an unpleasant odor.

The application of whitewash whether done with a brush or spray machine should aim to put as much ma-

terial on the surface as will remain there without running off. No attempt should be made to stretch out such mixture as is necessary with oil paint.

All whitewash mixtures gain a greater anchorage on the surface and are more serviceable when put on hot. The most practical equipment for such work is a portable kettle like a stock food cooker or similar to tar kettles on wheels used by roofers.

Colored Whitewash.—Any of the whitewashes may be colored with limeproof or mortar colors made for tinting brick mortar, concrete and cement surfaces. Painter's dry colors such as yellow ochre, Venetian red, lampblack, raw and burnt umber, raw and burnt sienna may be added to whitewash to make light tints and shades. It is not wise to mix dark colors in this manner because so large a percentage of color must be used that the durability or adhesive ability of the paint may be impaired. Chrome yellow, chrome green and Prussian blue must not be used with whitewash since they are adversely affected by alkali.

Paint for Weather-beaten Surface.—Occasionally a painter is called upon to paint a building which has stood in the weather for years. The joints, nail holes, cracks and even the pores of the lumber have opened up wide. Such a surface will absorb an unbelieveable amount of paint mixed in the ordinary manner.

The problem is to fill up such a surface and stop suction to make a good appearance, and in doing so a good foundation for the finishing coats must be made, a foundation which will firmly anchor itself and avoid cracking and scaling later on. Many methods are offered for such work but most of them have serious defects, principally that they are only temporary and offer an insecure foundation and one which will not avoid scaling off.

Because so much paint is required by such a surface —it usually soaks up paint like a sponge—the search is

for a cheap paint. That would be logical if it were not for the fact that the coat of paint next to the wood is the most important of all, it is the very foundation of the job. If cheap paint is to be used, far better to put it on last, not first.

Some painters go to the extreme of soaking such a dry weather-beaten surface with water, using a garden hose. Thus the wood is swelled enough to close the pores temporarily while the paint is put on. Then there is a risk of having the sun draw the water out and blistering the paint. And, of course, as soon as all the water drys out of the wood the pores and cracks open up again. It is a bad method.

Undoubtedly the best way to paint such a surface is by spreading on a second coat of paint mixed this way:

50 lbs. white lead
50 lbs. bolted whiting
3 to 4 gal. boiled linseed oil
½ gal. turpentine
Tinting colors

This paint should be mixed as thick as is necessary to fill the pores and yet it must be thin enough to brush out. Such a paint is in reality a thin putty, just such as is used for holding glass in place on window sash. If you ever had to dig such putty off of old window sash you'll remember that it took a sharp chisel to do it. So there is no doubt that such paint will attach itself firmly to the weather-beaten wood which, of course, offers more opportunity for anchorage. But on the other hand, if this paint were put on to pitch pine or any other wood filled with sap or gum there is just as much certainty that it would crack and scale off. Again, we see that paint must fit the surface it is to protect and decorate.

Paint so mixed is cheaper somewhat than usual because the whiting costs less than lead or zinc. It should,

however, be used only on the second coat. The first coat, and the third when put on, should be mixed as usual.

Keeping White Lead in Good Condition.—To keep white lead paste in good condition after the keg has been opened and some of the contents used, simply cover the remaining lead with water. Carefully scrape the lead off the sides of the keg first, however. Before using the lead again, pour off all the water.

CHAPTER VII

TINTING COLORS AND THEIR USE

A STUDY of this subject may approach the many colors used by the painter and decorator from various angles. The subject is, indeed, a large one, but the author believes that the purposes for which this book is written will be best served if the colors commonly used are simply enumerated and described as to uses rather than as to composition, origin and chemical characteristics.

The subject of tinting colors was considered at length in the book "The Mixing of Colors and Paints" by the author. In that work various colors were grouped and described as earth colors, chemical colors, aniline and coal tar colors, lake colors, vegetable colors, animal colors and metallic bronze colors. Color pigments were further grouped according to color hues and a full description of the characteristics of each color was given.

The list of colors used by interior decorators and by artists includes a great many color pigments which are not commonly used for exterior painting purposes. Many of these colors lack permanency in strong light; although satisfactory for interiors, many of them are far too expensive to be used for large exterior surfaces. The tinting colors made for house painters are also used by decorators and artists, but such colors are then ground finer and are usually more transparent than is necessary for tinting house paints. Most of the tinting colors used for exterior house paints are mined from the earth like coal, or are made by chemical manufac-

turing processes. The umbers, siennas, ochres and Venetian red are the most notable of the earth pigments, while Prussian blue, chrome yellow, chrome green and lampblack are the best known color pigments made by chemical manufacturing processes.

The tinting colors made for coloring white paint, are put up in a thick paste form and sold in tubes, 1 and 5 pound cans and in 12½ and 25 pound pails. Larger packages can be had for special purposes. This paste is thinned down with linseed oil or turpentine to brushing consistency and may, of course, be used as a paint in itself, but usually such colors are used for mixing with white paint to produce tints and shades.

Nothing is gained by buying lower grade colors because the tinting strength is reduced by the addition of extenders and, consequently, a greater quantity of such tinting color must be used to secure the tints or shades wanted. It will pay the painter to buy the best grade of tinting colors because they are brighter, clearer and have greater tinting strength than colors made to fit a low price. Cheap grades of tinting colors not only lack tinting strength, but they are apt to be muddy or cloudy.

Below is a list of the tinting colors most commonly used by painters for exterior paints and to a large extent for interior paints. There are some variations in names of tinting colors, because some manufacturers give special names to certain grades or shades of earth and chemical colors.

TINTING COLORS GROUND IN OIL

Reds

Scarlet Vermilion	Indian Red
English Vermilion	Tuscan Red
Unfading Vermilion	Turkey Red
Permanent Red	Venetian Red

Blues

Prussian Blue	Chinese Blue
Ultramarine Blue	Cobalt Blue

Yellows

Dutch Pink	Light or Canary Chrome Yellow
Golden Ochre	Medium Chrome Yellow
Yellow Ochre	Orange Chrome Yellow
French Yellow Ochre	

Blacks

Lamp Black	Coach Black
Carbon Black	English Blue Black
Black Iron Oxide	Ivory Drop Black

Greens

Forest Green, light, medium and dark	Light Chrome Green
Emerald Green	Medium Chrome Green
Olive Green	Bottle Green
	Bronze Green

Browns

Burnt Umber	Raw Sienna
Vandyke Brown	Burnt Sienna
Brunswick Brown	Raw Umber

CHARACTERISTIC OF COLOR PIGMENTS

Opaque Colors.—These are such as hide the surface more or less completely. The blacks are the most conspicuous, of course, in this group.

In the red group of tinting colors for house paints all cover well; Venetian red, Indian red and American vermilion hide the surface very well.

Among the blue pigments all are quite opaque, except when mixed thin for glazing and staining.

Of the yellows, the chrome yellows being made on a white lead base, are the most opaque. In fact, the other yellows are commonly used as glaze colors because they possess a degree of transparency. Yellow ochre, except

in the high grades of French ochre, is rather opaque and too muddy, as the decorator puts it, to be used for glazing or mixing stains.

Greens are rather opaque, yet they are transparent enough in most grades to be used for glazing when mixed thin. Browns are also fairly opaque when finely ground and used in a thick film, but all are excellent glaze colors, because of their degree of transparency when mixed thin.

White pigments which are really opaque are limited in number. White lead has held first place in the matter of opacity for hundreds of years and its many virtues may keep it in first place indefinitely.

Of recent years titanium oxide has made claim to honors as the most opaque white pigment, but its case has not yet been fully substantiated as an all-around equal to white lead.

Zinc Oxide has held second place for opacity among white pigments suitable for outside painting and it has held first place in the matter of fineness for years. It is not so opaque as white lead, however.

Then, considering only the quality of opaqueness and not general utility as a paint pigment, china clay and whiting, silica and barytes are less opaque white pigments, but are very useful for some purposes in interior decorating.

For interior wall paints, window-shade paints and enamel undercoaters, lithophone has first claim to popularity, because of its very great opacity and moderate cost. It is not suitable for exterior paints, however.

Transparent Colors.—These are not really transparent in the sense that glass is transparent, but they are semi-transparent when mixed thin. The glaze colors and especially the lake colors and aniline colors are the best examples of the transparent class, but even the commonly good grades of tinting colors for house paints are satisfactorily transparent for some jobs of glazing,

mottling, blending and Tiffany finish. For mixing stains, only the transparent colors are suitable. The aniline colors, being especially transparent, are very fine for both staining and glazing.

The Fading of Colors.—Among all the colors used some are very permanent, some fairly permanent and others are quite fugitive when placed in strong light or subjected to the elements on exterior surfaces. And it should also be remembered that many colors which prove quite fugitive and unsatisfactory when used for the wrong purposes are really suitable and satisfactory when used for the purpose for which they were manufactured. For instance, the beautiful lake colors made for superfine automobile painting and to be protected by many coats of varnish, would not give satisfactory service if used to tint outside paint. Bright colors made with Prussian blue, chrome green and certain anilines will not hold their colors long in direct sunlight, yet there are no more permanent colors of their kind to take their place. If judgment is shown about using fugitive colors, placing them out of strong light or on interior surfaces, they are completely satisfactory.

Earth colors such as Venetian red, raw and burnt umber, raw and burnt sienna, yellow ochre, and some few others are, generally speaking, more permanent than chemical colors like Prussian blue, chrome green and chrome yellow; but, as stated, the latter are sufficiently permanent for the purpose of house decorating, and there are no others to take their place. If blues and greens are to be used for exterior exposure, mix them with earth colors to increase their permanency; that will dim their brightness, but when added to white or black, pleasing tints and shades are secured.

Following is a tabulation of colors arranged according to their permanence in light:

NON-FADING

Raw Sienna	Venetian Red
Burnt Sienna	Chromium Oxide Green
Lamp Black	Toluidine Red
Ivory Drop Black	Yellow Ochre
Carbon Black	Tuscan Red
Black Oxide of Iron	Vermilion
Indian Red	Ultramarine Blue (except when used with white lead)
Raw Umber	Cobalt Blue
Burnt Umber	
Vandyke Brown	

FAIRLY PERMANENT

Chrome Green, Light	Chrome Green, Dark
Chrome Yellow, Light	Chrome Yellow, Orange
Chrome Green, Medium	Cadmium Yellow
Chrome Yellow, Medium	Para Red (aniline)

FUGITIVE

Prussian Blue	Yellow Lake
Antwerp Blue	Carmine
Chinese Blue	Crimson Lake
Dutch Pink	Scarlet Lake
Red Lead	Purple Madder
Aniline Reds (except Toluidine)	Madder Lake
Indigo	Rose Madder
Indian Yellow	Purple Carmine
	Violet Carmine

MIXING COLORED PAINTS

The first operation necessary to mixing tints and shades of colors and all except the very dark colors is to mix a white paint as described in Chapter VI. The white paint may be thinned to its final brushing consistency or only to a very thin, workable paste before the tinting colors are added. The colors should be added before the white paint has been finally strained. The tinting colors to be used should be mixed

with oil or turpentine until the paste is thoroughly broken up and is thin enough to be strained through fine screen or cheese cloth. One or more tinting colors are then added to the white paint and thoroughly stirred in so that each amount of tinting color added is well incorporated and shows its full tinting strength before more color is added. If a thorough job of mixing is not done little dark streaks of color will appear in the paint when it is being brushed out on the surface.

A batch of white paint being tinted always looks darker in color in the pot than when brushed out on the surface. You should, therefore, test your color by brushing it out on a board. The tinting color should be added in very small amounts because it is very easy to put in too much and then a considerable amount of white paint will be required to bring the color back to where you want it. Before adding the final amount of tinting color, it is a good plan to strain your paint if the tinting color has not been previously strained, and if there is any doubt about the paint being thoroughly mixed. The straining will catch any lumps of color, break them up and make them exert their tinting strength on the white paint.

Dry tinting colors are not suitable for tinting paint, as a rule, although in emergency they are sometimes used. The dry color should be mixed with oil or turpentine and rubbed out on a piece of glass or board with a spatula, putty knife or smooth mixing paddle and then strained well before adding to the white paint. This precaution is necessary to break up the lumps of color and to eliminate any grit.

Mixing Dark Colors.—Light tints and shades of paint are simply white paints having a small amount of tinting color mixed in with them. As the paints are made darker the amount of white paint in the composition, of course, decreases. When it comes to mixing very dark colored paint like chocolate brown, deep reds, dark

greens and blues, there is little or no white paint in such compositions.

When only small amounts of dark colored paints are needed, the most convenient way often is to mix them from regular tinting colors ground in oil, thinning such color pastes down with linseed oil or turpentine and adding a little japan drier. This makes a rather expensive paint, however, with certain colors and the tinting strength of such paint is lost to some extent or, at least, a paint with less tinting strength would serve the purpose quite as well. Consequently, when many gallons of dark colored paint are needed it is often more economical to purchase the colors wanted in the form of factory-made ready-mixed paint.

First class tinting colors are necessarily stronger in tinting quality than dark colored ready-mixed paints which are made only for coloring and protecting a surface. Paint manufacturers are able to mix the dark colored paints in a less expensive way by using chemically pure tinting colors with less expensive basic pigments not commonly available for painters' use.

Proficiency in Color Mixing.—Some painters and decorators are most skillful in the mixing of colors to match or harmonize with other surfaces, and there is a common expression to the effect that a good color mixer is born, not made. As a matter of fact, there is little truth in these words, although, of course, a mastery of color mixing comes more easily to some than to others simply because the environment and associations in the life of some people are such as educate them to a greater appreciation of color values.

The two prime essentials in a study of color to make one proficient in mixing and matching are: first, an understanding of color theory as it relates to primary and secondary colors of the spectrum, the influence of one color on another; secondly, a thorough knowledge of color pigments commonly used,—as to their prop-

erties, tinting strength, opacity or transparency and other characteristics. One need not go deeply into the theory of color and light reflections, but it is absolutely necessary to study diligently everything which relates to the color pigments available to the painter and decorator.

One of the best ways to become acquainted with color pigments, their influences and values is to secure a pound can, or small tube, of each of the colors listed in this chapter. Then, take a piece of plate glass and a spatula or a putty knife and make a study of one color at a time. Suppose you take the first color on the list—Indian red. Place a small amount of the color paste on the glass and rub part of it out to a thin coating to note how the color hue changes when the light passes through it. Then, add a very small bit of white lead or zinc to a part of this red and mix the two together in varying proportions to note the tinting strength and the character tints made by such mixing. Then, take a little of the same red and mix it with lampblack and note the character of the shades so produced. Next, mix with the Indian red a little blue and note the result. Continue these mixings with yellow, green, brown, etc., until you have fixed in your mind the particular color hues which result from the use of Indian red. Now take another red—perhaps American vermilion. Note that Indian red has a bluish character and is rather dull in hue, while vermilion has a yellow character and is much brighter. Note for instance that the pinks mixed from Indian red and white are rather dull and uninteresting, having a bluish cast, while the pinks mixed from American vermilion are clear, bright and more interesting. Note, also, that the purples and violets mixed from Indian red and blue are quite different from those mixed from vermilion and blue.

COLOR CARDS AND FORMULAS

For the mixing of house paints there really is no need for a painter to have for reference an extended list of color formulas, at least this is true after a painter learns the color hue and characteristics of each of the most common tinting colors. The formulas and color cards which follow are prepared simply to give the student a foundation upon which to build a more extensive knowledge of color mixing formulas.

Black Paint.—For exterior surfaces ordinary lampblack is commonly mixed to dry with a gloss by reducing lampblack ground in oil to a paste form with linseed oil, a little turpentine and a little japan drier. In this case the drier should be used whether raw or boiled linseed oil is used, because lampblack is a slow-drying pigment.

If the paint is to dry flat, use no linseed oil, but thin the lampblack entirely with turpentine using a little japan drier, or thin the black with flatting oil. When a black is wanted for a finer job of painting such as for furniture or automobile surfaces use drop black, which is sometimes called ivory black. If the surface is to be gloss, ivory black ground to a paste in oil and thinned with linseed oil or turpentine and a little varnish will give you the black paint wanted. If the surface is to be flat without any gloss, use ivory black ground to a paste in japan and thinned with turpentine, or with flatting oil or with flat drying varnish.

Gray Paint.—Any white paint to which lampblack or ivory black is added will give you a gray which is not so very interesting. If you will add to the black and white a little raw umber or, in fact, a very little of umber, raw sienna and a touch of red or blue you will produce gray shades which are much more interesting than the crude raw color resulting from black and white.

Brown Paints, Color Card No. 1.—In the list of tinting colors printed in the first part of this chapter six browns are given. From this number burnt umber, Vandyke brown and Brunswick brown are the only ones which are really of a pure brown tone. Raw sienna in the paste form is a light brown, but when mixed with white it produces yellow tints. Burnt sienna is a reddish brown in the paste form, but when mixed with white it gives pink tints. Raw umber is a grayish brown in the paste form and when mixed with white it produces warm gray or drab tints.

An uninteresting chocolate brown paint results from mixing burnt umber with boiled linseed oil and a little turpentine. Vandyke brown mixed in the same manner gives a more interesting brown and one with a warm hue.

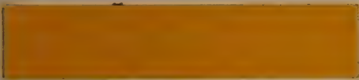
A very good dark brown may be mixed from 25 pounds of burnt umber, 10 pounds of burnt sienna and 1 or 2 ounces of chrome yellow, all of which are used to tint 100 pounds of white lead. Color card No. 1 shows burnt umber in the paste form, which you will note, is a very dark brown, almost black.

Color Card No. 2.—Browns and tans may be mixed in many ways with different combinations of burnt umber, raw umber and raw sienna. The color shown on card No. 2 may be mixed by the use of 1 pound of burnt umber with 40 pounds of white lead or a combination of 40 pounds of white lead and zinc.

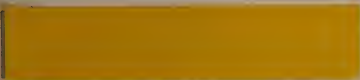
Yellow Paints, Color Card No. 3.—The two most commonly used yellow paints for exterior surfaces are mixed from chrome yellow, medium light or dark, and from raw sienna. The chrome yellows are much brighter and are satisfactory from the standpoint of durability, but raw sienna makes yellow paints which are among the most durable of colors when exposed to sunlight and the weather. Color card No. 3 shows medium chrome yellow tinting color without any white

No. 1 Burnt Umber (only)

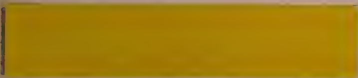
No. 2 1 lb. Burnt Umber
40 lbs. White Lead



No. 3 Medium Chrome Yellow (only)



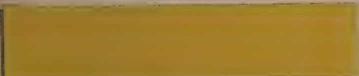
No. 4 1 lb. Medium Chrome Yellow
20 lbs. White Lead



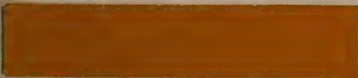
No. 5 1 lb. Medium Chrome Yellow
60 lbs. White Lead

No. 6 Raw Sienna (only)

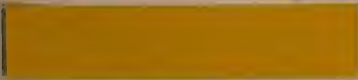
No. 7 1 lb. Raw Sienna
10 lbs. White Lead



No. 8 1 lb. Raw Sienna
60 lbs. White Lead



No. 9 French Yellow Ochre (only)



No. 10 1 lb. French Yellow Ochre
10 lbs. White Lead

No. 11 Venetian Red (only)

No 12 1 lb. Venetian Red
10 lbs. White Lead

No. 13 1 lb. Venetian Red
60 lbs. White Lead

No. 14 Burnt Sienna (only)

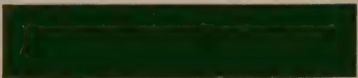
No. 15 1 lb. Burnt Sienna
10 lbs. White Lead

No. 16 1 lb. Burnt Sienna
60 lbs. White Lead

No. 17 Prussian Blue (only)

No. 18 1 lb. Prussian Blue
100 lbs. White Lead

No. 19 1 lb. Prussian Blue
160 lbs. White Lead



No. 20 Light Chrome Green (only)

or other pigment mixed with it. This color paste mixed with boiled linseed oil and turpentine makes a paint which covers and hides a surface exceptionally well. It makes a rather expensive paint, however, and it is, therefore, customary when painting large surfaces with chrome yellow, or a mixture of chrome yellow and white called colonial yellow to use but little yellow in the undercoats. In other words, the first and second coats are white paint tinted to an ivory or cream color with medium chrome yellow, or raw sienna and then only the finishing coat is mixed from medium chrome yellow principally. In this way some of the expensive tinting color, chrome yellow, is saved with no detriment to the job.

Color Card No. 4 is a yellow paint made by mixing 1 pound of medium chrome yellow with 20 pounds of white lead or white lead and zinc paste.

Color Card No. 5 is a cream color mixed with 1 pound of medium chrome yellow and 60 pounds of white lead paste or white lead and zinc. A more durable color of a very similar character, color card No. 8, is made from raw sienna.

Color Card No. 6.—This is raw sienna tinting color paste as it comes from the can without any addition of white or any other color.

Color Card No. 7.—In this we have a very interesting light tan color made by tinting 10 pounds of white lead or white lead and zinc with 1 pound of raw sienna. This is both a very attractive color and one which is exceedingly durable when subjected to sunlight and the elements.

Color Card No. 8.—A cream color which is a most durable and substantial color for exterior surfaces. It is mixed by using 60 pounds of white lead, or lead and zinc, with 1 pound of raw sienna. Some very attractive ivory tints can be produced in the same manner by using less sienna with the same amount of white.

Color Card No. 9.—This is yellow ochre tinting color in the paste form without admixture of white or other colors. It is an earth color which is very durable in the weather and when exposed to strong light. French yellow ochre is much superior to the common grades both in the brilliance of its color and tinting strength. The best of yellow ochres are very similar to raw sienna.

Color Card No. 10.—An interesting light tan or buff color mixed by tinting 10 pounds of white with 1 pound of high-quality yellow ochre. Tints and shades mixed with cheap grades of yellow ochre which are muddy and lack tinting strength are decidedly uninteresting and should not be used. Raw sienna tints and shades are much to be preferred. All of these color paints are to be mixed with boiled linseed oil and a little turpentine. If raw linseed oil is used, a small amount of japan drier is required. Chrome yellow and raw sienna dry well, but yellow ochre is a slow-drying pigment, as a rule, and requires more drier.

Red Paints, Color Card No. 11.—Very few exterior surfaces require red paints which are brilliant of hue. The red shown on color card No. 11 is rather bright and it is permanent as to color when exposed to bright sunlight and the weather. This color is mixed, using only Venetian red and boiled linseed oil in the proportion of about 3½ to 4½ gallons of oil to 100 pounds of red. About 1 pint or 1 quart of turpentine may be added to make the paint work more freely under the brush and penetrate a little more. If raw oil is used a bit of japan drier is needed. The color which is widely known as brick red is mixed in the proportion of 4 pounds of white lead, 2 pounds of Venetian and 1 pound of Indian red.

Color Card No. 12.—Rather a dull, light red mixed with 1 lb. of Venetian red and 10 lbs. of white lead.

Color Card No. 13.—A pink of pleasing hue and durable even in bright sunlight. For interior purposes

pinks made with American vermilion are brighter and more pleasing as a rule.

Color Card No. 14.—This is burnt sienna tinting color paste without any white or other color mixed with it. It is a decidedly permanent paint and will hold its color when subjected to the weather and bright sunshine for years. When the oil in the paint finally perishes, the color will be somewhat dulled and grayish, but if more oil were added to the surfaces its bright color would return.

Color Card No. 15.—A yellowish pink mixed with 10 pounds of white lead, or lead and zinc, and 1 pound of burnt sienna.

Color Card No. 16.—A light pink made from 60 pounds of white lead or lead and zinc and 1 pound of burnt sienna. More interesting pinks result from tinting white with American vermilion.

In addition to the above reds we have Tuscan and Indian red and vermilion all of which produce tints and shades with white which are of a slightly different character. When real bright reds are wanted American vermilion may be used with white paint. American vermilion is made on a lead base and is better for many purposes than English, French or Chinese vermilions which are made on a sulphur base. American vermilion, also, is less expensive and it is usually identically the same in color hue. There are several other reds on the market made from coal tar and aniline colors. Some of them are very permanent as to color and are called perma red, unfading vermilion and permanent red. The vermilion made on a sulphur base should not be used with white lead, because there is an unfavorable chemical reaction which results in turning the lead dark in color. The sulphur reds may, however, be used with zinc without such action.

All of these tints and shades are mixed into paint by the addition of boiled linseed oil and a little turpen-

tine, and when raw linseed oil is used, a small amount of first class japan drier is required.

Blue Paints, Color Card No. 17.—This card which appears to be black is painted with Prussian blue tinting color paste without the addition of white or other color. Prussian blue is one of the strongest tinting colors made and, in fact, it is so strong that a painter usually makes his first few mixes too dark. This blue, while extensively used, is not permanent in color when exposed to the sunlight, although it is satisfactory for tinting interior paints and for light blues used on porch ceilings.

Color Card No. 18.—A medium dark blue mixed with 100 pounds of white lead, or lead and zinc, and 1 pound of Prussian blue.

Color Card No. 19 is a blue paint mixed from 1 pound of Prussian blue and 160 pounds of white lead or lead and zinc.

All of these colored paints are made by thinning the colors and white lead with boiled linseed oil and a little turpentine. When raw linseed oil is used a small amount of japan drier is essential.

While Prussian blue is most extensively used by painters, there are several other blues, among them ultramarine and cobalt blue, which if anything are more interesting in hue than Prussian. These blues do not have the greenish hue which is characteristic of Prussian blue. Ultramarine and cobalt blues ought not to be mixed with white lead, because they have a sulphur content which turns white lead carbonate to lead sulphide which is black. These blues may be mixed with zinc, however, without this chemical action.

Green Paints, Color Card No. 20.—The color shown is a light chrome green, a color made chemically in a way similar to that used for producing Prussian blue. Chrome green may also be had in darker hues called medium and dark. The color card was made from light

chrome green without the mixture of white. The chrome greens are called fugitive colors, because they are not as permanent in strong light as such earth colors as the umbers and siennas. The chrome greens, however, are valuable color pigments which cannot be dispensed with, because there are no better colors to replace them. Dark chrome green is commonly used on window blinds and sometimes on roofs. A dark green paint which is more permanent to the light may be mixed, however, from raw umber, a little yellow ochre or raw sienna and just enough medium or dark green to add the color tone wanted. You can also mix green paints, of course, by using chrome yellow and Prussian blue and raw sienna. These green paints are likely to fade out in places more quickly than those made from chrome green, because there is a separation in the colors as they wear. Chrome green is a rather slow drying color and requires a little more japan drier than others.

There are other greens which are available for tinting paints and each has a slightly different color hue. They are bronze green, bottle green and emerald green.

Green paint is, of course, mixed by adding boiled linseed oil and a little turpentine to the color pigments. When raw linseed oil is used, a little more japan drier is needed. Light greens are mixed by tinting white lead or lead in zinc with medium chrome green.

Dark Colors at Less Cost.—When only a little dark colored paint is needed the mixing formulas suggested above will provide the paint. When a gallon or more of dark colors is needed it is probably wiser to buy a factory-made prepared paint of a suitable color. Such paint can be made a little lighter by adding white to it, if desired; or its color may be slightly changed by the addition of tinting colors in small amounts. Manufacturers are in position to make dark colored paints of good quality at less cost than that made by painters,

because they are able to tint less expensive pigments with very strong chemically pure colors and by the use of greater skill and knowledge of paint chemists.

More Attractive Colors.—We have considered so far the mixing of colored paint simply by adding a tinting color to white. Such a procedure seldom produces tints which are as attractive as those made by tinting white with more than one color. For instance, a tan may be mixed by adding burnt umber to white. Such a tan is rather lifeless. If you add a very little chrome yellow and a very little red you produce a tan which holds a great deal more of interest. In the mixing of grays the same thing is true. A much more interesting gray than that produced by a mixture of black and white are those grays which are made by mixing black and white and a little blue, or a little yellow, or a little red or all of these tinting colors to the black and white. The part to remember, then, is that colored paints mixed from two or three tinting colors and black, or white, are much to be preferred over two-color combinations. When you add a second or third color you may not be able to see that color in the paint, because such a small amount is used, but you may be sure that it has a favorable influence upon the paint.

CHAPTER VIII

FACTORY READY-MIXED PAINTS

THERE are many honest differences of opinion among men in the painting business and among men in the manufacturing business as to the merits of one paint over another. And like all other industries the paint trade is not made up of 100 per cent of honest men, so there are many good paints and some poor paints made to fit a low price usually. But the vast majority of men in the paint trade are sincere, honest and forward-looking individuals building business upon the firm foundation of merit and quality of their products.

We have large groups of painters and manufacturers who firmly believe in the single pigment paint, that is, in white lead and linseed oil. Another group believes that such paint is good but is made better by the addition of a second basic pigment—zinc oxide. Their belief is that white lead is a bit too soft and chalks or dusts off a surface too readily, that while zinc is too hard and brittle to be used alone as an exterior paint because it cracks and scales off, it does, nevertheless, add to white lead the quality it lacks. The theory is that each pigment—lead and zinc—adds to the other its desirable qualities and each eliminates the other's defects, and that when mixed together in correct proportions a better paint is made than that resulting from the use of either pigment alone.

The third group believes substantially what the other two groups believe about the value of lead and zinc as basic paint pigments, but believes also that the ad-

dition of certain inert pigments such as barytes, magnesium silicate (asbestine) or whiting in some form, reinforces the basic lead and zinc pigments and makes a more durable paint.

The point of greatest difference of opinion between these three groups is as to what percentages of zinc and inert pigments are best. And it is obvious to all who know the characteristics of lead, zinc, barytes, whiting, silica, clay, asbestine, titanox, etc., that paint is good or poor from the standpoint of durability without scaling, depending upon the proportions of various pigments used in it.

The author has no desire to tell you what is the best paint. You probably would not agree if he did. But by placing before you the characteristics of basic paint ingredients you are put in position to judge the values of paints more intelligently. But, after all, good service given by any particular brand or kind of paint, your own favorable experience with it, and the name of a reputable manufacturer on standard, well advertised brands count for most.

One outstanding fact about ready-mixed or prepared paints for exterior surfaces is that the best quality of such paints contains large percentages of white lead and zinc and small percentages of inert pigments. Whereas cheap, low quality paints for exterior surfaces contain small percentages of, or no, lead or zinc.

In substance the statements commonly made by manufacturers of factory-made mixed paints is that mixtures of white lead and zinc oxide properly balanced with moderate percentages of reinforcing pigments, such as magnesium silicate (asbestine), barytes, silica and calcium carbonate are most satisfactory from every standpoint, and are superior to mixtures of basic pigments not reinforced with inert pigments.

The perfect paint, of course, is that which protects and decorates a surface for a reasonable number of

years, and when repainting is necessary leaves a surface with a firm foundation for the new coats. Perfect paint is neither so soft as to chalk off prematurely or excessively, nor so hard as to crack and scale, necessitating the expense of burning and scraping before repainting can be successfully done.

The better grades of prepared paints for exterior surfaces show that about 85 per cent of the total pigment is white lead and zinc oxide, that the maximum amount of inert pigments is 15 per cent of the total pigment content, that the liquid portion is composed of linseed oil, turpentine or equivalent mineral spirits and the necessary drier and color.

It is evident that with so many variable factors prepared paint can be made which is good and serviceable and also such paint as is not good nor serviceable. To make good paints requires:

(a) The honest desire and intent to make the best of serviceable paint;

(b) The necessary chemical knowledge, skill and experience to make the most of available materials, because both good and poor paints can be made from the same materials;

(c) The use of the best pigments and liquid materials for the purpose and in correct proportions, making use of the cheaper inert or reinforcing pigments only to such extent as actually improves the paint by balancing up basic pigments and in accord with general experience of the trade.

The standard by which the value of exterior prepared paint may be fairly judged is:

1. It must cover 300 square feet or more per gallon of good surface with two coats, producing a uniform, evenly-colored surface with no dark or thin places.

2. It must produce a paint film which is not so hard and brittle as to crack and scale off when the wood expands and contracts with temperature changes,

nor so soft as to chalk off rapidly on exposure to the sun, nor wash off by the rain.

3. It must have an average life of three to five years of protection for the surface. And under favorable circumstances to wear much longer.

4. It must be durable in color, neither fading too rapidly in the sun, nor changing color, bleaching or discoloring, due to chemical reactions. The color of the paint under the dust and dirt accumulations to be the color judged.

5. It must leave the surface of the building in suitable condition for repainting, without the necessity for burning and scraping off the old paint. Only dusting off and puttying should be needed.

MIXING PREPARED PAINTS

These paints whether made for exterior or interior surfaces are thoroughly ground in the factories both to make the pigment fine and to incorporate the oil with the pigment, just as white lead and zinc are ground through powerful mills to incorporate the oil.

But after a can of prepared paint has stood on the shelf for some weeks or months the oil comes to the top and the pigment settles to the bottom. In high quality paints the pigment should not, however, get hard, even after separating from the oil. More or less mixing is required to make prepared paint ready for the brush. The best way to go about this mixing follows:—

1. Before opening a can shake it well;
2. Cut the top out with a putty knife and pour the liquid off into a clean pot;
3. With a clean, flat paddle stir the pigment left in the can with a little of the liquid until it is soft and all pigment has been raised off the bottom.
4. Now pour back the liquid removed, a little

at a time, stirring each lot until it disappears into the pigment.

5. When all the liquid has been stirred into the pigment strain the paint through fly screen and pour it into another clean pot. Repeat two or three times, pouring the paint from one pot to another and it will be ready for the brush.

Adding More Liquids.—Factory prepared paints are made thick enough to cover well in one coat over a surface of similar color. When used for the priming coat on new wood the paint should be thinned about 25 per cent for the first coat only. To each gallon of paint, therefore, add about 1½ pints of boiled linseed oil and ½ pint turpentine when the wood is of average fairly absorbent character. When the wood is yellow pitch pine, cypress or any wood which is well filled with gum, resin or sap streaks, it is better to add to each gallon of paint about 1 pint of boiled linseed oil and 1 pint of turpentine for the priming coat only.

On two-coat jobs use the paint without thinning for the second coat.

For three-coat jobs the paint for the second coat requires a little thinning to make it dry semi-flat and permit the third coat to take hold and dry without running, sagging or creeping and crawling, as it will when put onto a second coat of high gloss. Thin the second coat with about 1 pint of turpentine for each gallon of paint on three-coat work. For the third coat use the paint without adding more liquid.

Changing Colors.—Any factory-prepared paint may be changed as to color simply by adding the correct tinting colors or other colors of prepared paint. Tinting colors should be mixed well with a little turpentine or linseed oil and be strained before adding to the paint. White factory-prepared paints may be tinted

the same as white lead and zinc white paints, using the same tinting colors in the same way.

Characteristics of Pigments.—White paints and light tints which necessarily contain large percentages of white pigments, are more expensive than dark colored paints. This is true because there are only a few basic white pigments which are opaque when mixed with oil.

White lead (carbonate), white lead (sublimed) zinc oxide, leaded zinc, lithopone and titanium oxide (titanox) are opaque—they hide a surface well—when mixed with oil and when dry.

Whiting, silica, barytes, clay and one or two others are quite as opaque as the above group when compared in the dry form, but this latter group is made up of white pigments which are too transparent when mixed with oil to serve as basic paint pigments.

There are, of course, many dark colored pigments which make durable and satisfactory paints and which are even more opaque than the basic white pigments. Some of these are: lampblack, raw and burnt umber, raw and burnt sienna, graphite, aluminum bronze, Venetian red, etc.

White pigments are usually divided into two groups, depending upon their character when mixed with a liquid like linseed oil.

In the first group of white pigments which are noted for their property of imparting a white color, opacity or hiding power, to paints are these pigments which are commonly known and used:—white lead, zinc oxide, lithopone and titanium oxide.

In the second group are the pigments which are called extender or reinforcing pigments. In the dry state they are white, but when mixed with a liquid like linseed oil and spread as paint they have very little opacity or ability to hide the surface. In this second group are the following pigments:—

Barium Sulphate—(barytes, blanc fixe, permanent white)

Silica—(silex, silicious earth)

Magnesium Silicate—(asbestus, asbestine, pulp, talc)

Alumina—(China clay, precipitated alumina, feldspar, kaolin, alumina hydrate)

Calcium Sulphate—(gypsum, terra alba)

Calcium Carbonate—(white mineral primer, Paris white, whiting)

Bulking Values of Pigments, Dry.—The following figures are commonly used to indicate the values of pigments and are useful only to those who do more or less grinding of paints for various purposes:

Opaque Pigments, Dry	Specific Gravity	Weight per solid U.S. Gal.	100 lbs. pigment bulk in gallons
Basic Carbonate W. Lead	6.8	57	1.76
Zinc Oxide	5.7	47	2.12
Zinc Oxide, high leaded	5.9	49	2.00
Lithopone	4.3	36	2.80
Titanox	4.3	36	2.80
Extender Pigments			
Barytes	4.4	37	2.70
Asbestine, Magnesium Sil	2.9	24	4.20
Whiting	2.7	22	4.43
Silica	2.6	22	4.53
China Clay	2.6	22	4.58

Titanium Oxide.—One of the new paint pigments but recently perfected. It is receiving widespread attention. While it is not sold to the painter as a separate pigment, like white lead and zinc, it is, however, being used as a basic pigment with zinc in prepared house paints.

Titanox is a trade name for a white opaque pigment the essential part of which is titanium oxide.

A most interesting account of the development of titanium oxide was given by C. H. Hall, Pittsburgh Plate Glass Co., before the Minnesota Master Painters Association. This address in part follows:

"The development of new pigments in the paint industry, from the nature of the business, is naturally slow and conservative. The need of white pigments for exterior use having improved properties over those now available has, however, been forcibly demonstrated by the great technical development in the industry in the last fifteen years. (Note 1) While several products offer promise from a strictly scientific standpoint, very few have held out possibilities from a practical one. The oxides of a number of the less common metals, one of which is tin, produce white opaque pigments, but are impracticable from an economic standpoint.

"To produce a pigment which is commercially practical, raw material must be reasonably cheap and readily available in practically unlimited quantities so as to permit the production of a product either decidedly cheaper or decidedly better than those now available.

"Until recently titanium has been classified as one of the rare minerals, although the recent investigations and reports of the Geological Survey show that it is widely distributed throughout the earth in abundant quantities. It exists in its most abundant form as the mineral ilmenite, which is a combination with iron, containing between 40 and 50 per cent of titanium oxide. The pure oxide has an opacity of approximately three times white lead and double that of zinc oxide, but it is found that if a base of proper fineness and texture

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Author's Notes.—While discussing this subject with other authorities the author found general agreement with Mr. Hall's statements. There were, however, a few points where divergent conclusions were drawn. A brief statement of these differences will no doubt be of interest to readers:

Note 1—To supplement Mr. Hall's remarks it may be added that this development of new pigments has resulted in the production of numerous different types of paint coatings composed of various pigments and modern vehicles to meet the varying conditions of surfaces and structures, largely additional to the exterior wood surfaces of houses.

is added that when only 25 per cent of the pure oxide is present and 75 per cent of the base, that the pigment has an opacity equal to 85 to 90 per cent of the pure material. (Note 2). Above this percentage an increase in the titanium oxide, therefore, adds little or nothing to the opacity;—on the other hand, a decrease decreases the opacity in direct proportion to the decrease of titanium oxide. At this point, therefore,—namely, with a content of 25 per cent titanium oxide—the material offers the greatest economic value, and in consequence has made the production of the pigment practical, as the great amount of raw material and the expense of purifying the titanium solution would otherwise make the pigment so expensive that it could not compete in a large way with standard white pigments.

"The color, when iron is completely eliminated, is a very clear white, and produces with tinting material tints of a very clear tone. Its opacity is approximately three times that of white lead and double that of zinc oxide. In giving these figures it is understood that where a given weight of the material is spread over a given surface, the above figures are correct. (Note 3).

"Chemically, the pigment is extremely stable, being practically inert and unaffected by ordinary acid and alkalies. It is in no way dissolved or changed by various gases in the atmosphere. On exposure alone it chalks somewhat more than white lead, chalking beginning on the average at a somewhat earlier date. Alone, titanium

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Note 2—It has been suggested that the opacity of pure titanium oxide might be a bit more conservatively stated as being fully twice that of white lead and of zinc oxide.

Note 3—Again as to the opacity of pure titanium oxide, the point is stated by another authority in these words:—"The opacity of the precipitated composite type titanium oxide pigment is approximately two times that of the usual white opaque pigments used in exterior paints. These figures are based on relative hiding power, weight basis, and not on tinting power, weight basis.

oxide pigment does not make a satisfactory exterior paint and its use alone should be scrupulously avoided. (Note 4). The chalking feature is, of course, very desirable, but at the same time it is desirable that this be retarded to the maximum time possible, without the possibility of developing checking. When the proper steps are taken to do this, an article is produced which has the various properties described below, and which in a way is revolutionary from a paint standpoint. (Note 5).

"1. Has about one half greater opacity than paints now considered standard when thinned for painting. (Note 6).

"2. Can be furnished of a consistency that permits the master painter to reduce readily without having

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Note 4—As stated by Mr. Hall this paragraph is rather all inclusive. It might be modified in this way:—"In most exterior coatings the use of titanium alone should be scrupulously avoided."

Note 5—Speaking about control of chalking, particularly to retard it to the extreme, it may be well to add that when proper steps are taken to do this a commercial paint particularly suitable for painters' use is produced.

Note 6—Comparing titanium oxide paint with paints now considered standard, it is the opinion of other authorities that the titanium paint has considerably more opacity.

Other points of interest about this new pigment as given out by the manufacturers are these:

Titanox, the trade name for a titanium oxide paint, is a true composite pigment consisting of titanium dioxide precipitated and coalesced with barium sulphate base (blanc fixe).

The properties listed are: color, white; structure, very fine uniform powder; hiding power, greater than that of any other white pigment; chemically stable and inert.

It is highly resistant to both acids and alkalies; it is unaffected by action of sunlight or gases and is inert toward other pigments, tinting materials and with oils and vehicles. Titanox may, therefore be used with any of the grinding liquids, varnishes and oil without danger of chemical reactions which may result in livering, hardening or granulation. Withstands high baking temperatures without discoloration.

to break up a heavy paste, but at the same time to fit all conditions of surface and drying.

"3. Can be used for tinting with any color available whatever, without fear of reaction, or can be mixed with any other white pigments.

"4. Produces a paint which is remarkably more adaptable to spraying because it can be applied thin and cover perfectly.

"5. Dries to a smooth, high gloss surface of superior whiteness which eventually chalks moderately without showing indications of checking or cracking.

"6. On account of superior opacity will still obscure surface as well as standard paints after chalking has progressed for a very considerable time.

"7. On chalking, tints become lighter, as do those made from lead, but on tests made over a wide range of country and on a large amount of surface it has always been observed that a remarkable uniformity of color is maintained without predominance of blotched and variegated colors so often in evidence on a chalking surface.

"8. Can be used in industrial sections around gas works or oil fields where it comes in contact with hydrogen sulphide fumes, without any discoloration. Under such conditions any paint containing lead is at once discolored."

Lithopone.—This is a very white and very opaque paint pigment which is composed of barium sulphate (blank fixe) and zinc sulphide. The very dense white and hiding power of this pigment makes it valuable as the base for most of the flat wall paints which are used extensively. It is also used in manufacturing processes for painting purposes;—the painting of window shades is a notable example of the use of lithopone.

Lithopone in ordinary grades turns gray when exposed to sunlight, but recovers whiteness when placed in the dark. In the higher classes of lithopone the

material retains its whiteness when exposed to light.

Quite recently special grades of lithopone have been developed for use in exterior paints. Mixtures of 40 per cent zinc, 40 per cent lithopone and 20 per cent inert pigments are being sold for exterior painting purposes with assurances from manufacturers that such paints have been subjected to durability tests and found satisfactory.

Whiting.—This is calcium carbonate and appears on the market as a bolted whiting for ordinary purposes such as making putty and as cliff stone and Paris white and gilders' whiting in finer grades.

Whiting is a fine white powder, the product of limestone which has been crushed and graded by floating off the fine chalk in water. The fine chalk pigment, after being separated from the coarse rock, is dried and then is ready for the decorator and painter. Whiting is the principal base for calcimine. Plaster of Paris, which is sulphate of lime, is a kindred product and is used by decorators in filling cracks in plaster walls.

Silica (Silex).—This is a product obtained from crushing rock crystals, quartz, sand and flint into a fine powder form. The principal characteristics of silica are its great hardness and the fact that it is inert, having no chemical reactions on any other pigments, colors or oils with which it is mixed. In the dry powder form it is rather white, but on being mixed with an oil it changes to a yellow sand color. As the particles themselves are colorless, they take on the color of the oil with which they are mixed. The use of silica by the painter and decorator is largely in the form of paste wood fillers. Small quantities are used in undercoats of wall paints to give them a "tooth" which will make the second coat of paint hide the surface better, because more pigment can then be retained on the surface without running, sagging and wrinkling.

Barytes.—This is a white pigment which is found as

a natural product the world over and usually with lead and zinc metal ores. It is prepared for the paint trade by grinding and the separation of the impurities by an acid bath and water washing.

Barytes is a stable product chemically and does not set up chemical reaction with any of the materials with which it is mixed. This character of being inert has made it the most popular base upon which chemical colors are made. Barytes is practically colorless, so takes on the color of whatever substance it is mixed with. It can be used to dilute strong colors without modifying their tone.

Barytes is not used by the painter as such, but has long been used by manufacturers, both in color making and paint making, and authorities claim that it actually increases the durability of paints.

Asbestine (magnesium silicate).—This is a product of asbestos which does not come to the painter as such, but is used in the manufacture of prepared paint because it is very light and fluffy. Its particles are rather long, narrow fibres, rather than round, and it is used as a sort of reinforcement in paints just as hair is used in plaster. Its other prime purpose is to help hold the paint pigments in suspension in the liquids. Some paints have a tendency, when sealed up in cans and allowed to stand on the dealers' shelves for a long time, to settle to the bottom of the can. The asbestine, as stated, has a tendency to keep the paint pigment in solution. This pigment is one of the forms of asbestus or talc.

Stock White.—This term today usually refers to factory-made prepared paints in white. There is no standard formula. What is commonly considered a good formula is mixed approximately like this:—

45 lbs. white lead
45 lbs. zinc oxide

10 lbs. silica, barytes or whiting
3¼ gal. boiled linseed oil
The 100 lbs. of pigments plus 25 lbs of oil, or oil, turpentine and drier make about 8 gal. of paint.
Such paint is about 60 per cent pigment and 40 per cent liquids and mixes to about the correct brushing consistency for third coat work.

The term—stock white—came into use years ago because of the custom in many paint shops of breaking up white lead with linseed oil in advance of its needs. When the shop man was not busy the white lead was mixed with linseed oil, reduced to a paste consistency too thick to be brushed. It was largely a means of giving employment to the men, but it also saved time when paint was needed in a hurry. Enough paint to last a week or two was so mixed and when a few gallons were needed for a job the white paste was taken from the tub, thinned further and tinted any color wanted.

Prince's Mineral.—An iron oxide earth pigment color of reddish brown. Ground to paste form with linseed oil. It is thinned with linseed oil, turpentine and drier by the painter and used for rough factory surfaces —fences, roofs, barns, metal roofs and other metal surfaces. It makes a paint which is both durable as to color and protection for the surface.

CHAPTER IX

PAINT OILS, THINNERS, DRIERS AND REMOVERS

PROGRESS in the development and manufacture of painting and decorating materials is rapid indeed. What may be written as an absolute fact today may be true only in part a few months hence. This is true largely because more enterprising and open-minded men than those engaged in the paint, varnish and allied industries are not to be found in the marts of trade the world over. They deal with facts established by science. As each new truth is uncovered it is subjected to the tests of science and of time. When established by both, few men fail to accept the step forward and prepare for the next step.

So it is with paint oils and thinners. We cannot say truthfully that this is completely good and that is hopelessly bad. There are qualifications for all paint materials. Conditions under which such materials are to be used are always a special consideration which determines values when the characteristics of any oils, paints, varnishes, enamels, etc. are being discussed.

Purpose Served by Paint Oil.—A drying oil in paint serves several purposes. In the first place it converts dry colors and dry basic paint pigments into a liquid state, thus making it practical to spread the pigments to a uniform thickness over the entire surface. The oil binds the pigment particles together and attaches them to the surface. The oil protects the pigments, provides a gloss finish and together the oil and pigments exclude moisture and air from the surface.

About Drying Oils.—Quite a number of drying oils are known to chemistry and the manufacturing field.

The outstanding oil which has greatest utility and value is linseed. It comes to the painter and decorator in several forms, such as raw, boiled, refined, bleached and what are called special oils. The other drying oils in common use are poppy-seed oil, China wood oil (tung oil), nut oil, parella oil, lumbang oil, sunflower-seed oil and a fish oil under the name of menhaden. There are other oils now going the rounds of chemical laboratories, but their commercial values have not been established.

Painters and decorators need concern themselves with none of these oils, except linseed, poppy-seed and, possibly, China wood (tung) oil. Linseed oil is used almost exclusively for exterior paints and, in small quantities, as the binder for interior paints. When used in white paints for interior decorating, linseed oil is likely to turn yellow, but will bleach out white again when subjected to strong light. Poppy-seed oil and nut oil are used with artists' colors for pictorial painting and for some other special paints where the quality of extreme whiteness is valuable. China wood oil is used chiefly in the manufacture of certain kinds of varnish and flat wall paints for interior use. The balance of the drying oils are used for special purposes by manufacturers in the making of paints which require peculiar quality; for instance, fish oil will withstand a great deal of heat, when mixed with a paint, without causing the paint to blister. Fish oil, therefore, is valuable for use in paint to be used on engines, smokestacks, metal roofs and radiators, which are subjected to high temperatures.

There are some other oils classed as semi-drying oils which painters and decorators hear about, but which are of no use to them in their natural state. These oils are corn oil, cottonseed oil and soya-bean oil; all are classed as vegetable oils. They are used by manufacturers to

some extent for admixture with linseed oil and driers in the grinding of paste paints and colors.

Linseed Oil.—Sold in barrels by weight. Manufacturers and jobbers use 7½ pounds as a standard gallon. The correct weight for a gallon of oil is 7.7 pounds (commonly stated as 7¾ pounds for convenience). A 50-gallon barrel is therefore short about 1½ gallons to pay for the barrel. A one-gallon measure will hold 7¾ pounds, but when filled to the lip with oil congealed by a low temperature a gallon measure will hold as much as 8 pounds.

Oil barrels are marked, not with the number of gallons of oil contained, but with a gross weight and a tare weight in pounds. The gross weight includes the weight of the barrel and its contents. Subtract the tare weight from the gross weight and you have the net weight of the oil contained in the barrel. Divide the net weight by 7½ and the result is the number of gallons, figured by the commercial standard gallon.

Linseed oil is the most extensively used paint oil, not only because of its valuable characteristics, but because it is obtainable in abundant quantities at moderate prices wherever flax is grown. The abundance of linseed oil naturally keeps the cost down to a moderate figure. It is generally understood the world over and, consequently, uniformly good results are secured from its use. Linseed oil is, of course, used extensively in the making of soap, linoleum and in many manufacturing processes by which all manner of merchandise is made.

The manufacture of pure raw linseed oil is accomplished by crushing flaxseed, known to some as linseed, between large steel rollers in mills constructed especially for the purpose. The oil is squeezed from the seed, allowed to settle and age in order to remove the mucilaginous matter which settles to the bottom of the tanks. The longer the oil is aged the better, but in the modern

process of manufacture most of the mucilaginous matter, called foots, is removed by filtering the oil while it is hot.

Raw linseed oil is, as its name implies, a rather crude raw product, and when used in paints must have a drier added to it, usually, to make the paint dry rapidly enough during cool and damp weather. As a matter of fact, on outside painting it is customary to add drier to raw linseed oil in any weather, although during hot, dry seasons the oil will dry without the use of japan drier. There is always some risk that the paint will dry too slowly, without driers, to avoid the accumulations of dust, small flies or gnats in swarms.

Boiled linseed oil is much to be preferred to raw oil when you can secure one of the brands made by a reputable manufacturer. The average manufacturer considers raw linseed oil simply as a commercial product, a commodity which must be made within certain standards of purity, to be sure; but boiled linseed oil is made with pride and especial care to give maximum results in drying and brushing qualities as well as in the matter of durability.

A great many painters have steadfastly bought pure raw linseed oil because it offers less opportunity for unscrupulous manufacturers to cover up adulteration; it is more difficult to detect the addition of dope oils to the boiled linseed oil. However, it is a better buying policy to secure high-class boiled linseed oil from a manufacturer of good reputation who makes advertised brands. Such an oil is an institution with the manufacturer and he takes pride in setting up and maintaining a high standard of quality in his boiled oil. He makes an oil of uniform quality, doubly filtered and free from moisture and foots. With that kind of an oil, painters and decorators will get better results, have fewer painting problems, and even though the oil costs

a few cents a gallon more than if raw oil were used, it will be a better investment.

The mucilaginous matter, or foots, found in linseed oil is a substance which may appear in even the best filtered and prepared oil, because it is a substance formed by changes of temperature and it comes entirely from the oil itself. In other words, the best of care known to manufacturers may be exercised in the making of a pure linseed oil, either raw or boiled, and yet if the barrel is subjected to many or extreme changes of temperature after it leaves the factory, the painter may find a considerable quantity of foots in the last few gallons drawn from the barrel. Foots do not constitute adulteration of the oil, and when they occur they can be returned to the reputable manufacturer and exchanged for clear oil without cost to the painter.

In brands of high-grade boiled linseed oil most of the foots have been removed by heating, chilling and filtering. The oil when it leaves the factory is entirely suitable for painting purposes. It is possible and practical to completely remove all foots from linseed oil; indeed, that is regularly done with oils made for special manufacturing purposes. It requires a rather elaborate chemical process to remove all foots, and that makes the oil cost eight or ten cents per gallon more. For ordinary painting purposes there is no advantage in removing every trace of foots from the oil; at least, it is not worth the extra cost, generally speaking.

If the painter will just be alert and not use any of the thick oil from the bottom of an occasional barrel containing foots, he will experience no difficulty. If this oil is used by a careless workman it may retard the drying of the paint, causing it to remain soft and tacky for a long time. Then it may become discolored by accumulations of dust or insect swarms.

High-class boiled linseed oil is made by filtering and heating the raw oil in large tanks to 240 degrees of

temperature. This is to eliminate the moisture. Then high quality drying substances, such as manganese, red lead, litharge, raw umber and cobalt driers are added while the oil is still hot to thoroughly incorporate them. After this the oil is cooled down and thoroughly filtered. The oil is not actually boiled, as the name would indicate, as that would require raising the temperature to 600 degrees of heat. Such a high temperature will cause the oil to become thicker and darker in color. For all practical purposes raising the temperature to 240 degrees is sufficient to eliminate the moisture.

There is reason to be cautious in buying boiled linseed oil from any but the well known and firmly established manufacturers, because there has been a practice indulged in by some paint jobbers and others of making so-called boiled linseed oil which has not been high-grade material. This material has gained the name of bung-hole boiled oil, because it has been the practice of these firms to buy barrels of pure raw linseed oil, draw out a few gallons through the bung-hole and replace the pure linseed oil with driers of their own making. In some instances adulterated oils have been put into the barrels because they were cheaper. This is bound to be inferior oil, even when these men start with pure, raw linseed oil and have no intention of doping it. They have not adequate manufacturing facilities to make good boiled linseed oil, and even if good driers were added they would not be thoroughly incorporated when put into the barrel in this manner with the cold oil. In other words, to make the oil right they would have to remove it from the barrels, heat and filter it and thoroughly incorporate the driers. They are not equipped to do that.

When the makers of bung-hole boiled oil add cheaper oils, like deodorized fish oil and mineral oil, to pure linseed oil in order to increase their profits, the painter is likely to have considerable trouble with his paints

because they are slow drying or remain soft and tacky indefinitely. In the case of white paints the adulterated oils may cause the paint to turn yellow.

Authorities on the subject of paint oils have looked diligently for a cheaper oil than linseed oil and one that would be just as good or better. They have not found one available in sufficient quantities up to this time. When such an oil is found, and has been proven by a few years of testing to be equal to the job, you will hear all about it from the paint trade in general and the reputable manufacturer.

As a general proposition, paint oils offered as a substitute for linseed oil for outside house paints are valuable only in proportion to the amount of pure linseed oil they contain.

To the average painter or decorator pure linseed oil is all alike, but as a matter of fact there are differences, even though the prices are all about the same. It is therefore a wise policy to select a brand of boiled linseed oil of known quality made by one of the manufacturers who has an acknowledged reputable standing in the trade, and therefore secure oil which is uniform in quality from the beginning of the year to the end. You will do your mixing of paint after certain set formulas which you may have in print, or simply in your head from long practice, and it is obvious that any formula will give you better results if the basic materials specified in the formula are always of the same quality as to the small content of foots, uniform color and absence of moisture. There is some ground for doubting that painters can mix as durable or as uniform paint by using pure, raw linseed oil and japan drier as by using the oil produced by manufacturers of high-class boiled linseed oil. By using boiled linseed oil you avoid the risk of having careless painters adding too much drier to your raw linseed oil, thus wasting the drier which is expensive and injuring the paint. Of course, japan drier

should always be measured before adding a quantity to your paint, but it is only human for a painter to guess at it. If he has good judgment, guessing is all right, but many workmen are careless about this.

It should be perfectly obvious, of course, that where there is any question about the high quality of the boiled linseed oil at hand it is much better to use pure raw oil with the addition of good japan drier.

The preference for raw or boiled linseed oil will be found to vary considerably in different parts of the country. Something more than half of the total amount of linseed oil in the United States is boiled. In some sections almost 100 per cent boiled oil is used, while in others raw oil is used in the largest proportion, depending somewhat upon habits and training of the painters.

There is just one certain way to secure a dependable linseed oil, either raw or boiled—that is, to buy from one of the reputable manufacturers of such products. Following is a list of the manufacturers of pure linseed oil. In several states laws have been enacted which require manufacturers of linseed oil to attach labels to the barrels, or cans, which read "pure linseed oil." Such a label, which carries the name of a reliable manufacturer and his address is assurance in these states that the oil is pure.

American Linseed Co., New York, Boston, Chicago, St. Louis.
National Lead Co.'s Brands—"Atlantic," "John T. Lewis & Bros. Co.," "Dutch Boy."
Archer-Daniels-Midland Co., Minneapolis.
Hirst & Begley Linseed Works, Chicago.
Kelloggs & Miller, Amsterdam, N. Y.
Mann Bros. & Co., Buffalo, N. Y.
Spencer Kellogg & Sons, Buffalo, N. Y.
Minnesota Linseed Oil Co.. Minneapolis, Minn.
Red Wing Linseed Co., Red Wing, Minn.
Sherwin-Williams Co., Cleveland, O.
Fredonia Linseed Oil Works, Fredonia, Kan.
Pacific Oil & Lead Works, San Francisco, Cal.
Wm. O. Goodrich & Co., Milwaukee, Wis.
Bisbee Linseed Co., Philadelphia.

How Oil Dries.—China wood oil apparently dries

simultaneously from bottom to top,—that is, it seems to get hard and solid through the whole thickness of the film at once. Linseed oil on the other hand dries by absorbing oxygen from the air and since more oxygen is available on the outer surface a dry skin forms on the outer surface first and the drying proceeds from the outside in toward the surface of the wood or metal upon which the oil or paint is spread. This is true whether the oil is raw or boiled, but the skin is formed more quickly by the boiled oil. Apparently the boiled oil dries first but actually it does not,—the drying is going on all the while under the top skin.

Testing Linseed Oil.—There has been a great deal of idle talk and useless writing in the painting business for years about tests for this material and that, for everything used in the business. Much of it has amounted to amateurs attempting to perform chemical analyses without any education in the science of chemistry.

Some simple tests for comparing physical or mechanical properties of materials are both interesting and instructive, as well as useful to be sure. For instance, rubbing a paint pigment or a color out on a piece of glass with a knife to note whether it is coarse, gritty or crystalline in texture. And then on looking through the glass and pigments at strong light to note how opaque the paint is usually reveals facts which are both dependable and useful. The simple tests for determining the purity of white lead, using matches or a blow-pipe, charcoal and an alcohol lamp are dependable.

Among the quite useless tests are those which are conducted by amateurs to determine the purity of linseed oil. One of them is that of putting a few drops of the oil in the palm of the hand. Then by rubbing your palms together rapidly enough to heat the oil by friction a strong odor of the oil is given off. Pure oil is sure to give off the peculiar odor of linseed oil

cake. The test is also supposed to enable you to detect the odor of fish oil or mineral oil if such adulterants were used in extending the linseed oil. But what makes this interesting little test quite useless is the fact that fish oil is now so perfectly refined as to be entirely without the fishy odor and its color is also cleared up and changed. Those attempting adulteration of oil in this day are clever enough to do it so well that simple tests will not reveal their scheme.

Then there are many other tests indulged in like magic,—the placing of a drop of sulphuric acid on a film of oil on a piece of glass,—called the spot test. If the acid burns a clean hole through the oil film, leaving a round brown spot it is supposed to prove that the oil is pure, but if the spot of acid spreads like a cobweb, the oil is said to be impure. The test doesn't prove anything—it works both ways.

And there's the bottle test. Oil put into a clean bottle and shaken well is supposed to show bubbles with brightly colored hues when the oil has been doped. But again, as the skeptics say,—it's interesting if true.

The hard facts are that only men with professional training in chemistry and with proper laboratory facilities are in position to make tests of linseed oil and arrive at results which are dependable. If your education has given you enough training in chemistry to enable you to understand and conduct the chemical tests indicated in the following specifications you may profitably spend time testing linseed oil. Otherwise, you will profit more by buying only oil made by manufacturers of known reputation for delivering pure oil. It's interesting for amateurs to fuss with chemistry, but the time so spent should be charged up to entertainment and should not be allowed to influence one's business buying policy.

In the testing of linseed oil chemists determine certain physical and chemical values. Oils made from flax seed

grown in different parts of the world show somewhat different properties. Oil made from North American flax seed has been carefully studied by a committee of the American Society for Testing Materials. The specifications issued by this society for pure raw and pure boiled linseed oil made from North American seed are these:

Raw Linseed Oil

	Maximum	Minimum
Specific gravity at $\frac{15.5 \text{ deg. C}}{15.5 \text{ deg. C}}$.	0.936	0.932
Specific gravity at $\frac{25 \text{ deg. C}}{25 \text{ deg. C}}$.	.931	.927
Acid number	6	....
Saponification number	195	189
Unsaponifiable matter, per cent .	1.50	....
Refractive index at 25 deg. C ...	1.4805	1.4790
Iodine number (Hanus)	....	180

Boiled Linseed Oil

	Maximum	Minimum
Specific gravity at $\frac{15.5 \text{ deg. C}}{15.5 \text{ deg. C}}$.	0.945	0.937
Acid number	8	....
Saponification number	195	189
Unsaponifiable matter, per cent .	1.5	
Refractive index at 25 deg. C ...	1.484	1.479
Iodine number (Hanus)	....	178
Ash, per cent	.7	....
Manganese, per cent	....	.1
Calcium, per cent	.3	.2
Lead, per cent	....	.03

Paint Defects Caused by Adulterated Oils.—Whether any ill effects result from the use of doped oil depends upon conditions. Even as much as a 25 per cent adulteration with some semi-drying or even non-drying oils may not show any immediate defects, if the oil is used in paint on very soft, spongy or weather-beaten wood when the temperature is high and ventilation is good. But a very slight adulteration will sometimes give no end of trouble when such oil is used in paint spread over hard, non-absorbent surfaces like pitch pine, cypress, metal, etc. The extent and kind of adulteration, the weather and surface conditions, therefore, govern the result.

The ill effects resulting from the use of adulterated linseed oil are these, principally:

Tacky and non-drying of paint; paint has been known to remain soft and tacky for two or more years where doped oil was used.

Discoloration of painted surfaces often results from tacky paint containing doped oil. The paint accumulates dust, smoke, soot or insects lodge in the paint greatly discoloring it.

Oil doped with mineral oil will turn white paint yellow.

More than a dozen years ago the adulteration of linseed oil was quite common, but with the advent of the Federal Trade Commission and the active co-operation of the manufacturers who are members of the National Paint, Oil and Varnish Association, Inc., this detrimental practice has been almost but not completely eliminated.

Prepared Paint Oils.—Of recent years a number of paint oils have been sold which appear to be giving good service. These are specially prepared oils made by reputable and skilled paint and varnish manufacturers, using China wood oil or soya bean oil after refining treatment of the raw or crude oils. These are called reinforcing oils and are used in prepared paints,

largely. Such reinforcing oils are offered to the painter and when China wood oil or soya-bean oil is correctly treated by the manufacturers to make it suitable and sold by responsible firms they are worth careful trial and study.

Perilla Oil.—Produced from seeds of perilla which grows in China, Japan and India. While it is a drying oil and appears in the American market in a very limited way, it is not used in a commercial way in the paint industry. Tests made of this oil by the American Society for Testing Materials and the Paint Manufacturers' Association resulted in its being considered superior to linseed oil by some. Perilla oil is considered of a high commercial value as a paint and varnish material in the Orient. The cultivation of the plant is being introduced into the United States.

China Wood Oil (Tung).—The use and popularity of this oil has increased greatly in the last ten years, and while the decorator and painter do not come in contact with it often as an oil, they do use vast quantities of it as part of interior flat wall paint and varnishes.

From China wood oil a varnish is made which dries flat and is the principal liquid of flat wall paints. Although this oil is not extensively used in paints for general purposes, it may be so used in the future. It is used in making marine paints today, because of its ability to withstand the action of salt air and salt water.

China wood oil comes from the Orient and is made from nuts of certain trees. Unlike most oils, it dries with a flat, waxlike appearance and is not transparent when dry. It has an odor which is not forgotten easily, though it is not unpleasant. This oil is not used in its raw state, but is usually cooked with resins or such drying substances as manganese, lead oxides, red lead, litharge or cobalt, and then thinned with turpentine or mineral spirits. The cooking causes China wood oil to dry with a gloss, rather than the flat appearance of the

raw oil. This oil is used in the making of some excellent varnishes.

China wood oil is one of the best drying oils known. It requires only about one day to dry, whereas linseed oil requires about three days and poppy seed oil requires from two to five days.

This oil has remarkable waterproofing properties. It is used for this purpose extensively in China for such as paper umbrellas, boats, etc. To the submerged bottoms of boats the oil is put on hot, but cold oil is used on the exposed areas above water. This oil has been used in building forts with tri-partite earth, lime, sand, oil and clay, making a material almost as tough as granite. And the peculiar value of the wood from this tree makes it very desirable for the manufacture of lutes. Insects do not attack it.

China wood oil ought not to be used in the raw state, as it dries opaque and not smooth but crinkly. When the oil is boiled without drier at 230 degrees F. it can be used the same as linseed oil and dries transparent. One of the first difficulties encountered in handling this oil was that above a temperature of about 400 degrees F. it was likely to go with great rapidity into a jelly, which was insoluble with the known oil solvents and consequently became useless. Linseed oil can be raised to a temperature of 600 degrees. It is thought that this oil should not be used alone, but in combination with linseed oil. When so used the China wood oil imparts the hardness and non-porosity, while the linseed oil contributes the elasticity.

Soya-Bean Oil.—A vegetable oil made from soya beans, grown extensively in Manchuria and Korea, and to some extent in the United States as animal feed. Soya beans belong to the same family as the ordinary pea and bean. This oil dries very slowly and makes a soft film. The cost of it is low compared to linseed oil, and it is, therefore, used sometimes to adulterate linseed

oil. Soya-bean oil is in rather general use by manufacturers in the paint industry for prepared materials, but is not used by painters and decorators as a raw oil. Chemists say that as much as 25 per cent of soya-bean oil can be added to linseed oil for painting purposes without injury to the film. Certain colors ground in soya-bean oil appear to be more satisfactory than when ground in linseed oil.

Menhaden Fish Oil.—Produced from menhaden fish, mostly. Considered a drying oil and recommended by the chemists for use in smokestack and metal roof paints and for paints subjected to moist, salt air. It will not blister the paint on hot surfaces.

Kerosene and Petroleum Oils.—Except benzine, these oils serve no good purpose in paints used by the painter and decorator, as they are non-drying liquids. They are used for certain special metal paints where a small quantity of these oils is needed to retard the hard drying of the paint, but they should be used only by expert manufacturers who know exactly what to do and how.

Kerosene used by painters and decorators is quite certain to cause trouble with tacky paint. It will turn white paint yellow. Some marine painters claim to have used kerosene successfully on wood boats, but it is more than likely that they had more good luck than good sense.

Creosote Oil.—An oil distilled from coal tar and which is heavier than water. It is also called heavy oil and dead oil in some industries.

Its outstanding value is as a preservative of wood, and so it is known as a base for shingle stains.

The odor of creosote oil is a strong characteristic and one not likely to be forgotten easily.

When not carefully refined for use in stains, creosote oil is apt to throw down a sediment in cold weather. This settling or separation of color and liquid can be overcome when the manufacturer exercises due care in

chilling and filtering the oil before permitting its use in stains.

Turpentine.—One gallon of turpentine weighs 7.2 pounds, but a commercial standard gallon is called 6¾ pounds. This is probably the most important volatile thinner used by the painting trades for paints and varnishes. It is manufactured by distilling the resin of the long-leaf pine trees of America. Rosin also results from the distillation of the sap of pine trees. At first turpentine was made only from the resin or gum obtained from the tree, and that product is now known as gum turpentine. Turpentine is also extracted from the sawdust and stumps by steam distillation or destructive distillation of the wood and is known as wood turpentine.

Wood turpentine has a disagreeable odor if not very carefully refined and usually is not so uniform in quality. The odor can be removed to a satisfactory degree and the characteristics of wood turpentine can be refined to approach closely those of gum turpentine.

Turpentine has certain very valuable solvent and flatting properties for paint and varnish products. The painter and decorator finds that when mixed with white and colored pigments it makes a paint which flows well, penetrates and dries without gloss.

The ability to penetrate into the pores of a surface is one of the outstanding virtues of turpentine. Pure turpentine evaporates almost completely after it has made the paint fluid, assisted in spreading the pigment to cover the surface uniformly and to penetrate it. But turpentine is not a binder in itself; on evaporation it leaves the pigment about as it was before it entered the paint, except that the pigment is more closely packed.

Turpentine has two objectionable properties for use inside of buildings; one, its very strong odor, which nauseates some people and is objectionable to a great many; the other is the ill effects turpentine causes on

one's kidneys. Unless decorators are unusually careful about securing ample ventilation when working with turpentine, they are apt to feel such ill effects as will prevent them from using turpentine for interior work. That is why many painters prefer benzine and appear to produce quite as good results with it on interior decorating. Benzine should not be used in place of turpentine for exterior painting.

Among the spirit thinners turpentine evaporates most slowly, more slowly than benzine or gasoline and very much more slowly than alcohol and benzol. Some of the especially distilled mineral spirits evaporate quite as slowly as turpentine. Sometimes turpentine is adulterated with non-volatile petroleum oils.

Turpentine oxidizes (takes on oxygen from the air like linseed oil) to some extent and assists the drying of paint. And while pure turpentine evaporated from a dish apparently leaves no residue, chemical analysis of paints containing turpentine recovers less of it than was put into the paint. A bit of rosin from the turpentine must, therefore, remain in the paint. On the other hand, all the benzine put into paint can be recovered by chemical analysis.

Turpentine Subsitutes.—These spirit liquids are usually mineral spirits made from Texas petroleum having an asphaltic base. They vary considerably in their properties as to specific gravity, flash point, ability as solvents and how completely they evaporate. The best grades should evaporate completely during drying, have good solvent power and cause no precipitation of gums or polymerized oil in paint and varnish. For the use of painters and decorators the mineral spirits having a flash point near that of turpentine are less of a fire risk and are the most desirable for that reason. In these petroleum spirits having satisfactory volatility and solvent power there may still be differences which cause satisfactory or unsatisfactory flowing, spreading

and general brush-working qualities in varnish, enamels and paints.

Mineral Spirits.—Petroleum from the Ohio and Pennsylvania oil fields has a paraffin base, while petroleum from the Texas oil fields has an asphaltic base.

Benzines of a higher gravity, and which evaporate more slowly, are made from Texas petroleum rather than from petroleum having a paraffin base. These benzines from Texas petroleum are called mineral spirits and they can be distilled to dry quite as slowly as turpentine.

Careful regulation of fractional distillation of petroleum with a paraffin base, however, produces mineral spirits similar to such benzines made from asphaltic petroleum.

Mineral spirits are not as satisfactory as pure turpentine for thinning japan colors or varnishes. In short oil varnishes this thinner will precipitate the varnish if used in any but very small amounts. For use with most flat paints and oil paints the best brands of mineral spirit substitutes for turpentine are very satisfactory. Such thinner is cheaper and less disagreeable to handle for thinning paints being applied with spray guns.

Benzine.—While this spirit is a petroleum product, it is an exception to the rule against the use of this class in paint. It is a volatile thinner which evaporates more or less completely after it has served the purpose of making the paint liquid so that it can be spread uniformly thick over a surface.

Benzine is a distilled, colorless liquid made from crude petroleum. It has a gravity of from 55 to 72 degrees by Baume hydrometer while gasoline, the lighter product from the same base, shows a gravity of from 60 to 62 degrees Baume. The heavier oils, like fuel oil and lubricating oils, are distilled from the same petroleum base.

Painters have been criticised for years because of their use of benzine, but such criticism has seldom been justified. Once in a while a lazy painter will add too much benzine to outside paint in order to make it brush onto the surface easier, but he usually gets caught soon enough, because the paint then dries without gloss.

Benzine has many good uses in a paint shop aside from its value for washing surfaces, brushes and pots. For flat wall finishing and in the hands of skilled decorators it serves quite as well as turpentine. It will, of course, cause the paint to brush out "short" and to "pile up" if not properly mixed as to proportion with oil.

Benzine has no place in exterior house paints because it does not possess the same ability as turpentine to penetrate the pores of the surface.

While benzine used in large amounts in rooms without ventilation causes ill effects—a "benzine jag"—as the painters call it, as generally used in place of turpentine it is far safer, less harmful to health and pleasanter.

Do not confuse benzine—(spelled with an "i")—with benzene. Benzine is a petroleum product, but benzene is similar to benzol and toluol, which are definite compounds derived from the light oil of coal tar.

Benzol.—A light oil distillate from coal tar which is a volatile spirit with a boiling point of 82 degrees C (180 degrees F). A powerful solvent of gums, resins, oils and varnishes. Sometimes called 160 degree solvent naphtha. Used by painters to add to paint for pitch pine surfaces or to brush on to such resin filled wood to cut the resin and give the paint an opportunity to penetrate and anchor itself.

Solvent Naphtha.—A distillate of light oil from coal tar. It boils principally between 130 degrees C (266 degrees F) and 160 degrees C (320 degrees F).

Solvent naphtha is commonly known to painters and

decorators as 160 degree benzol and is used by them in small amounts occasionally in exterior paint to be spread on to pitch pine or other woods the pores of which are completely filled with resin or an oily substance.

Solvent naphtha is less volatile (it evaporates more slowly) than benzol or toluol.

The excellent properties of solvent naphtha, as a solvent for bituminous paints, varnishes, gums, oils and resins has made it widely used in the paint and varnish industry. It is a common ingredient in paint and varnish removers and in substitutes for turpentine.

Amyl Acetate (banana oil).—This is the oil used commonly as the vehicle and binder for bronze paints —called bronzing liquid.

Amyl acetate, amyl alcohol and methyl alcohol are solvents used by manufacturers in nitrocellulose lacquers and, while painters and decorators read mention of them occasionally, there is little or no use for them as such in the ordinary course of business.

Alcohol (ethyl, grain, methyl, wood).—That used by painters is almost entirely denatured alcohol. It is grain or ethyl alcohol to which poisons are added (usually 5 per cent of wood alcohol and 5 per cent benzine or other petroleum distillate) according to government requirements, to denature it and make it unfit for human consumption.

Painters use denatured alcohol for many purposes,— for thinning shellac, for washing up wood trim after an old finish has been stripped off with liquid varnish removers and for mixing with water stains to secure penetration.

Wood alcohol (which is methyl alcohol) is not so extensively used. It is a powerful solvent of varnish and paint films and is used to some extent as a remover of these coatings. Wood alcohol is also a deadly poison.

Grain alcohol which has been denatured with 10 per

cent of wood alcohol (methyl) is called methylated spirits.

Special denatured alcohol like methylated spirits can be used only under bond in the United States and by manufacturers who are bound to use it for manufacturing purposes only and for sale as part of a finished product,—shellac is such a product. Grain alcohol is best to cut shellac but the special methylated spirits is next best for the purpose.

Driers.—Such metals as lead, manganese, cobalt, calcium, iron and zinc put into chemical compound solutions and added to drying oils hasten the drying of these liquids. Certain drying pigments,—red lead, lead acetate (sugar of lead) and litharge are also used. Linseed oil becomes dry by taking up oxygen from the air. The addition of drier speeds the rate of absorption of oxygen by the oil.

In the trade driers are listed as driers, oil driers, japan driers and as japans. The name on the can or barrel may not fairly indicate what class of drier will be found in the container, however, because these names are used rather indiscriminately.

Japan drier is a liquid most commonly made from solutions of lead and manganese salts, neutral linseed oil, resin or gum and turpentine or mineral spirits. It should dry to a hard film well attached to the surface when spread alone on a piece of glass for testing. Some such driers are made very light in color for white paints, but most of them are dark brown. Lead acetate (sugar of lead) and litharge are principally used in making the white or light colored driers.

Oil driers when properly made contain no gums or resins and do not dry to a hard film. As a rule oil driers made of both lead and manganese salts as an oleate are considered better than resinate driers and japans. A manganese drier will expand while drying and resists moisture better than lead driers. But, on

the other hand, driers made from lead salts, while they contract on drying, will withstand heat better. The usual manufacturing practice, therefore, is to use both lead and manganese salts to gain the virtues of both.

Some oils and pigments dry naturally to a greater or lesser degree in their own time. To hasten this drying, to make semi-drying liquids dry hard, driers are essential. And, generally, driers are needed to make the use of paint, varnish and other decorative and protective coatings dry within a reasonable time and with a hard surface having no tacky or sticky character.

Without the use of drier in paint during hot, humid or cold, wet weather, the paint may dry so slowly that dust, flies or gnats in swarms may accumulate on the paint and disfigure it.

As a matter of convenience it is essential that paint and varnish dry within a reasonable time to permit workmen to proceed with a job from day to day with one coat after another; and fairly rapid drying is essential, too, so that decorating done in buildings where people must continue to live and work will not soil clothes and persons.

For practical purposes, then, driers are essential in paint, varnish and other decorative and protective materials, but the durability or life of the coating is lessened by the use of driers. Therefore the use of the least amount of drier which will serve the purpose is always the proper guide when a coating is expected to be durable. As a general principle it may be said that the quickest drying coatings are the least durable; the slower drying the most durable.

This is readily understood when you know that the final destruction of a paint film is the result of oxidation. A substance like driers, which speeds the drying of paint, then, by that very fact, makes the life of that paint shorter.

This principle is of vital importance as a guide in

mixing exterior paints used as a protective coating on any surface. The use of too large a quantity of drier simply burns out the life of the oil and destruction of the paint film proceeds rapidly. It is for this reason that well informed master painters use a high grade boiled linseed oil and permit their journeymen painters to use no japan driers; a careless use of too large a quantity of japan drier with raw linseed oil is thus avoided. The use of japan drier which is not very strong overcomes this risk to some extent, but even then the careless workman simply guesses that even a larger quantity is needed, and so continues the abuse. Every ounce of driers used ought to be measured, but in actual practice the man who measures quantities of any material is a rare fellow in the painting business.

The use of driers in interior paints is quite another proposition. Durability is not, relatively, an important consideration. The paint will wear out from abrasion, or be repainted because it has become soiled or because a change of color is wanted, and so the life of the liquid binder calls for little consideration.

Paint Removers.—To remove paint from wood, metal and other surfaces we have recourse to three methods. It may be scraped off with steel scraping knives and sandpaper,—it may be burned with a torch paint burner and scraped off or it may be removed with a paste or liquid paint remover composed of chemicals which cut through and soften the paint enough to be scraped off. Formulas for paint and varnish removers are numerous, but many are not worth a thought. Some of the best of them are included in this section.

Painters are constantly seeking formulas for removers which can be made up at a lower cost per gallon than must be paid for the patented prepared removers sold by manufacturers and dealers. Once all the facts in the case are known the wise painter will not waste much time in this pursuit.

The cost of factory made removers is determined by the cost of the ingredients largely. The principal ingredient in the best removers is acetone and acetone is expensive. Most of the removers are made under one patent license and are very much like each other. The higher priced removers and the most effective have a large percentage of acetone in them while the cheaper and less effective removers have little or no acetone but rather depend upon wood alcohol as the solvent. Most of the removers contain wax or a similar substance which serves to hold the acetone or alcohol solvent on the surface for a longer time, thus making them more effective. Acetone, alcohol, benzole and similar solvents are very volatile,—that is, they evaporate and disappear speedily, unless retarded with wax. It is the use of wax in this connection which is the basis for the patent.

Paint removers are not used in large quantities, or at least not for large areas of surfaces. When large areas must be stripped sandpaper, scrapers and the paint burners are used. For stripping off paint and varnish from cabinet woods, furniture, fixtures, wood trim, etc., it is most convenient to use the prepared and patented removers sold for the purpose and it pays to buy the better quality removers. With wages at their present level a workman can easily waste more than enough time with home made removers to fully pay for enough patented remover to do the job. Time and labor costs are what count for most in the cost of doing most painting and decorating jobs, so these are the first elements to keep in mind when considering ways and means of reducing the cost of any materials. The factory made removers of the better class do their work with speed; they are harmless to handle since they do not burn the skin;—they are convenient and do not injure the wood, the tools or clothing.

The handling of removers made with caustic soda,

lye, hydrochloric acid and some other chemicals must be done with extreme care, because they burn the skin and clothing. Rubber gloves are needed. Then the handling of fusel oil, strong ammonia and some other chemicals with very strong odors is a disagreeable task, since they not only effect the nose but the eyes. The fumes from hydrochloric acid, for instance, are very injurious to health. Then the mixing of chemicals must be understood. For example when mixing sulphuric acid with water it is very dangerous to pour the water into a quantity of acid because an explosion occurs and scatters the acid in all directions. The acid must be put into the water a few drops at a time and even then an intense heat is set up. The mixing is usually done in a glass or earthen vessel submerged part way in cold water. And again, if quite a little water is put into a glass bottle with a number of sticks of caustic soda the intense heat from the chemical action will break the glass. The water must be added a little at a time.

The following formulas are those used in furniture factories and elsewhere. They have been used with success where large numbers of school desks and similar surfaces were to be stripped off by painters before refinishing:

Remover Formula No. 1

20 ounces caustic soda (98% strength)
100 ounces of water
Dissolve the caustic soda in the water a little at a time
20 ounces mineral oil (light machine oil)
20 ounces fine sawdust
Mix the oil into the water and soda by stirring well until an emulsion is formed, then stir in the sawdust well. Run the whole mass through a paint mill or mixer

and use the paste while fairly wet. Allow time enough for the remover to work, then scrape off the softened paint and clean up the surface thoroughly with water in which a little vinegar has been mixed to neutralize any soda left on the surface.

Remover Formula No. 2

8 pounds caustic soda (98%)
1 gallon water—dissolve the soda in the water
8 pounds bolted whiting
4 pounds corn starch

Mix thoroughly and use as a wet paste. Add more water if needed. Apply with old brushes, let stand long enough to soften the paint and scrape off. Use rubber gloves. Wash up with water and a little vinegar should be mixed into the water to neutralize the soda that may be left on the wood in the pores. Such soda would destroy new coats of paint or varnish if not washed off or neutralized.

Remover Formula No. 3

4 ounces benzole of 90 degree strength
3 ounces fusel oil
1 ounce wood alcohol

Remover Formula No. 4

5 quarts benzole, 90 degree strength
2½ pints acetone
½ pint carbon bisulphide
2 ounces paraffine wax

Mix the benzole and acetone, then add the last two items in the order given.

Remover Formula No. 5

1 gallon benzole, 90 degree strength
1 pint fusel oil
1 pint acetone
1½ ounces paraffine wax

Mix the benzole and fusel oil, add the acetone and finally the wax.

CHAPTER X

METAL PAINTS AND PAINTING

SUCH exterior surfaces as are constructed of metal are sometimes difficult to paint to assure permanent coatings and to avoid scaling. Each metal has its peculiarities and so each will be considered separately. Here are the surfaces which commonly engage the house painter's attention:

- Galvanized Iron Roofs, Gutters, Rain Spouts, Walls and Garages
- Copper Roof Decks, Spouts, Gutters, Store Fronts and Window Screens
- Zinc Roof Decks, Gutters, Spouts, etc.
- Structural Steel, Steel Window Frames and Sash, Steel Doors and Frames, Fences, Posts, Tanks, Stacks, Masts, Window Gratings, Porch and Stair Pipe Rails, Furniture, Fixtures, Conveyor Machinery, Bridges and Fire Escapes
- Iron Ornamental Work, Radiators, Pipes, Machines and Water Plugs

Metal Corrosion (rust).—Iron and steel result from the manufacturing processes of man. Iron ore as mined is mixed by nature with many substances. Iron has a powerful affinity, an attraction for certain other elements in nature, particularly for oxygen. Pure iron unmixed with other elements is never found in the natural state. When iron is purified in the chemical laboratory it must be sealed up free from contact with other substances. If not kept sealed up it instantly

absorbs other elements from the air and moisture. By such absorbing of other elements iron reverts to its original state;—as we say, it rusts or corrodes. By so doing it becomes iron oxide. Some of our tinting colors are oxides of iron,—Venetian red is perhaps the best known of these.

So we see that unless iron and steel are protected from contact with air and moisture by suitable paint they are constantly undergoing chemical destruction —a return to natural oxides, the mere red dust we call rust.

More than one theory is advanced to explain the rusting of iron and steel, but no matter what your theory of the cause of rusting, it is well settled that moisture starts the corroding action which forms rust. Some paints retard and some accelerate corrosion, but the long and the short of the problem is that to prevent rusting the painter must coat the surface with paint which will do two things—(a) stick permanently to the metal, (b) keep out moisture. And the paint which performs these two functions in the most nearly perfect manner is the best paint, other things being equal.

Considering the causes of corrosion, the rusting of iron and steel, it is interesting to note the facts that these metals do not rust unless moisture is present in the air nor in water unless air is present. Other elements in the air, especially near large cities, accelerate rusting of metals. The air of industrial communities is usually charged with coal smoke and many gases which speed corrosion of iron and steel. Sulphur dioxide and soot are no doubt the most destructive because together and in the presence of moisture they tend to form sulphuric acid.

Other facts of interest in connection with the painting of metal are these:—steel rusts more quickly than iron. Wrought iron doesn't rust at all. Iron and steel

are destroyed by corrosion more rapidly than wood is destroyed by decay and rot. When you paint over rust without removing it to the bright metal, the rusting continues. A coat of clear linseed oil over bright steel permits enough moisture to go through to rust the steel. The addition of pigments waterproofs the oil.

Atlantic City Paint Tests.—About 1908 an outdoor exposure test was made of various paints to determine the rust-proofing values and general qualities of metal paints. These tests were conducted by the American Society for Testing Materials in co-operation with the Paint Manufacturers' Association of the United States.

Atlantic City, N. J., was selected as a locality which is especially destructive of paint protective coatings. It was thought that results of the tests would be apparent here in the shortest time.

Each paint tested was spread on a steel plate. There were 300 such plates and over fifty paints. All were assembled to form a test fence. Three coats of each paint were applied to each plate after carefully cleaning it. Plenty of time was allowed each coat for drying. All edges were carefully coated as rust often starts in such places and the panels were insulated against electrolysis from any stray current leakage which might occur. All panels were handled alike and the application of the paint was as skillful as possible.

The committee selected to examine and report on the condition of these paints made its first report after two years' exposure. Judgment passed on the paints was based on chalking, checking, cracking, scaling, peeling, color and the condition of the surface for repainting. Panels were inspected every year and the final report at the end of four years' inspection and six years of exposure of the paint was based on an average of all points rated during all inspections. At the end of the fourth inspection very few panels remained in condition for further rating.

The final ratings given each kind of paint were stated by comparing each material with a theoretically perfect paint which was rated as 10 points. The ratings given each of the following paints were, then, in comparison with this perfect paint and indicate the paints having maximum value as rust-inhibitors. The tabulation is taken from the report of inspections over a period of five years by Sub-Committee IV of Committee D-1, of the American Society for Testing Materials:—(The rank arrangement is by the author)

Average Ratings of Metal Paints

A rating of 10 indicates a perfect paint

No.	PIGMENTS	Ratings by years					Final Rank
		1910	1911	1912	1913	1914	
34	American Vermilion (basic lead chromate)	9.1	10.0	9.9	9.8	7.5	1
5	Sublimed blue lead	9.6	8.8	9.0	7.2	6.0	2
21	Carbon black	8.3	7.2	7.0	6.8	5.0	3
41	Chrome green	9.8	9.8	8.6	7.6	5.0	3
20	Willow charcoal	8.8	8.8	8.6	7.9	4.5	4
10	Red lead	8.7	8.3	8.1	6.3	4.0	5
16	Natural graphite	9.1	6.8	6.6	6.2	4.0	5
39	Zinc chromate	9.4	9.5	8.8	8.0	4.0	5
49	Zinc and lead chromate	9.5	9.7	9.2	8.3	4.0	5
51	Magnetic black oxide	9.5	9.5	8.6	7.8	4.0	5
4	Sublimed white lead	9.5	9.0	8.1	5.9	3.5	6
36	Medium chrome yellow	7.0	7.7	6.0	5.2	3.5	6
44	Prussian blue (water stimulative)	9.2	9.0	7.8	6.7	3.5	6
9	Orange mineral	9.0	8.3	6.9	4.0	3.0	7
15	Metallic brown	6.3	6.3	6.2	6.1	3.0	7
12	Bright red oxide	9.3	8.1	6.7	4.5	2.5	8
40	Zinc and barium chromate	9.7	9.5	8.5	7.8	2.5	8

Concerning metal protective paints Dr. H. A. Gardner, American Society for Testing Materials, stated the case in these words:

"First—Basic pigments such as litharge, red lead, blue lead (basic sulphate), white lead, zinc oxide, inhibit the corrosion of iron.

"Second—Chromic compounds—basic lead chromate, normal lead chromate, zinc chromate—prevent the corrosion of iron.

"Third—So-called neutral or inert pigments, such as iron oxide, which do not excite corrosion, produce with linseed oil very durable films. Such pigments include black, brown and red oxides of iron, china clay, silica, talc and barium sulphate.

"Fourth—Substances that form a galvanic couple with steel in the presence of moisture cause rapid corrosion. Pigments which act in this fashion (graphite, carbon black, lampblack) are used only as constituents of finishing coats on steel surfaces, when first insulated from the metal by a coat of basic or chromate pigment paint. These carbon pigments with linseed oil form very durable and water-resisting coatings."

METAL PAINTING MATERIALS

Red Lead.—For a great many years red lead has been considered excellent paint for metal surfaces. It is a pigment of bright red color made for years by melting lead metal in open saucer-shaped kettles or furnaces. When the lead metal was thus kept in solution for hours it took up oxygen from the air and formed first a light yellow powder called litharge. Litharge is a powerful drier used in making japan drier. More time and heat changed the litharge to a brilliant red pigment which was red lead. Still more time and heat oxidized the red lead to an even more brilliant red called orange mineral. Today this process, while the same in principle, has been improved somewhat in application. Orange mineral is now made by roasting white lead.

The brilliant red color of red lead gradually fades on exposure as paint to the sunlight. As a color it has little value but the fading of the color doesn't impair the durability of the paint in the least or its ability to protect a surface.

When red lead containing a large percentage of litharge—even as much as 1 per cent—is mixed with linseed oil it has a tendency to harden in the pot rather quickly. It sets too rapidly to permit its being spread evenly over a surface except by skilled brush hands working diligently. Unless both skilled and conscientious men spread the paint a badly covered surface may result except when better red lead is used. And if more than a day's supply of such red lead paint is mixed there will be waste because what is held overnight may get hard in the buckets.

When dry red lead is used it is necessary to stir the paint every few minutes. The pigment is very heavy and settles to the bottom of the pot.

About 1913 a great improvement was made in red lead. Manufacturers learned how to eliminate the litharge by complete oxidation,—thus making red lead 100 per cent pure.

With this great accomplishment the defects of red lead were eliminated. Pure red lead does not dry more rapidly than white lead; in fact, it is necessary to add to such red lead the normal amount of japan drier used with raw linseed oil in white lead paint.

One hundred per cent pure red lead is now ground in linseed oil and sold in paste form. It is mixed by the painter and handled the same as white lead. It will keep, like white lead, indefinitely without getting hard in the container and the need for constant stirring of the pot of paint is no greater than for white lead, but it is, of course, wise to stir any paint often to keep the top of the same consistency as the bottom while being brushed.

In both laboratory and severe field tests red lead has proved itself unexcelled in its ability to stick to metal surfaces and to keep out moisture which starts corrosion and rusting.

Red lead in oil paste is obviously more convenient for

the painter to handle than dry red lead and it offers less chance for waste and consumes less time in the mixing. It is ground finer in the mills also and, consequently, covers more surface better.

Engineers and architects have experienced some difficulty in having dry red lead paints properly used to completely and evenly cover the iron and steel, both on shop coats and field coats, because of the difficulty of brushing out the paint from high and dangerous perches on bridges and structural steel sky-scrapers. But red lead-in-oil-paste works very easy under the brush and because it spreads as easily as any paint the surfaces are better painted.

Testing by Weight.—Government specifications which call for red lead paint usually require that the paint shall weigh not less than 26 pounds per gallon and not more than 28 pounds per gallon. Railroad, municipal, state and other public work specifications require a minimum weight of 24 pounds and a maximum of 28 pounds. Climatic and other conditions under which metal surfaces are painted greatly influence the weight per gallon which is best of red lead paint.

Red lead is the heaviest of paint pigments and so the sizes of the packages are the smallest,—a 100-lb. red lead keg is quite a bit smaller than a 100-lb. white lead keg. Consequently, when red lead paint paste has been mixed with other pigments the original packages will always be larger for the corresponding weights. Such mixed pigment paints weigh usually not over 18 pounds per gallon.

Red lead in oil paste must contain 97 per cent of true red lead or it will harden in the package. And it must be very fine and uniform or it cannot be oxidized to the extent of 97 per cent pure red lead. All of which means that any red lead ground in oil and sold in paste form, rather than dry, must be at least 97 per cent

pure red lead, leaving only 3 per cent for litharge or inert pigments.

MIXING FORMULAS—RED LEAD

The United States Navy specification for red lead (dry) mixed with linseed oil calls for 31 lbs. dry red lead and 1 gallon (7¾ lbs.) of linseed oil. 33 pounds of lead to the gallon of oil makes a better paint for the building field, however.

33 lbs. dry red lead
1 gal. linseed oil
½ pint japan drier if raw oil is used with 10 per cent pure red. Otherwise no drier is needed.
Makes about 1¼ gal. of paint
Weight per gallon 28 lbs.

or

100 lbs. red lead, dry
3 gal. linseed oil
1½ pts. japan drier, if raw oil is used with 100 per cent pure red lead.
Makes about 3¾ to 4 gal. of paint.

100 lbs. of red lead paste composed of 94 per cent pigment and 6 per cent oil bulks 2.13 (2¼) gallons.

Red lead-in-oil paste is mixed in the following proportions which are equivalent to 33 lbs. dry red lead to 1 gallon (7¾ lbs.) of linseed oil.

If raw linseed oil is used add about ½ pint of japan drier for each gallon of paint. If good boiled oil is to be had use 1/3 boiled oil and 2/3 raw oil:—

ORANGE RED (NATURAL COLOR)

100 lbs. red lead paste
1.98 gal. linseed oil (boiled)
Makes 4.11 gal. paint

or

50 lbs. red lead paste

1 gal. linseed oil (7¾ lbs.)
Makes 2.06 gal. of paint

One gallon of such paint contains 24.29 lbs. red lead and .48 gallons linseed oil (7¾ gallon). One gallon of this paint weighs about 28 lbs.

A red lead paint of thinner consistency may be mixed as follows:—

100 lbs. red lead paste
2.5 gal. linseed oil
Makes 4.6 gal. of paint

or

40 lbs. red lead paste
1 gal. linseed oil (7¾ lbs.)
Makes 1.85 gal. of paint

One gallon of the above paint contains 21.65 lbs. of red lead and .54 gallons of linseed oil. One gallon weighs 25.8 pounds.

Red lead paint may be tinted, using regular tinting colors, in oil the same as for white lead. It is desirable usually to tint the last coat at least one of the following colors:

BLACK RED LEAD PAINT

100 lbs. red lead paste
52 lbs. lamp black
16 lbs. Chinese blue
15.20 gal. linseed oil
Makes 24.55 gal. of paint

or

4.08 lbs. red lead paste
2.12 lbs. lamp black
.65 lbs. Chinese blue
.62 gal. linseed oil
Makes 1 gallon of paint
Weight per gallon 11.6 lbs.

DARK BROWN RED LEAD PAINT

100 lbs. red lead paste
6 lbs. lamp black
2.64 gal. linseed oil
Makes 6.42 gal. of paint

or

15.57 lbs. red lead paste
.93 lbs. lampblack
.57 gal. linseed oil
Makes 1 gal. of paint
Weight per gallon 20.9 lbs.

LIGHT GREEN RED LEAD PAINT

100 lbs. red lead paste
31 lbs. medium chrome yellow
13 lbs. Prussian blue
6.12 gal. linseed oil

or

9.48 lbs. red paste
2.94 lbs. medium chrome yellow
1.23 lbs. Prussian blue
.58 gal. linseed oil.
Weight per gallon 19½ pounds

OTHER COLORS

White, gray and any other tints and shades wanted for the finishing coats over red-lead painted metal surfaces may be mixed by using white lead or white lead tinted to suit as for wood surfaces. And, of course, any other white or colored paint may be used over the red lead priming coat. For white and light tints two coats are essential for a nice finish over the bright red. Dark grays and other shades often cover solidly and hide red lead in one coat.

Mix white lead for finishing coats over red lead as follows:

100 lbs. white lead
3½ to 4 gal. linseed oil
1 pint turpentine
Tinting colors
Makes about 6½ to 7 gallons of paint

Reinforced Red Lead Paint.—The Equipment Division, Ordnance Department, U. S. Army, during the world war made up a specification for such paint which reads as follows:

"This paint shall weigh not less than 16 pounds per gallon. It shall contain not less than 64 per cent pigment. The pigment portion shall contain 60 per cent red lead and 40 per cent of silicious matter such as magnesium or aluminum silicates and silica or a mixture thereof. The red lead used shall contain not less than 85 per cent Pb304, the balance to be Pb0.

"The liquids shall consist of 90 per cent of linseed oil and 10 per cent of combined drier and thinner. The thinner shall be turpentine.

"When applied to a smooth iron surface, this paint must dry in twelve hours without running, streaking or sagging."

Blue Lead.—It would seem from a study of the reports on the Atlantic City test fence that blue lead is a metal paint of first importance. It really has the first rank among these ratings because basic chromate of lead (American vermilion) is too expensive to be extensively used, without adulteration, for commercial paints.

At this point it should be remembered that there are bright red paints on the market which match American vermilion in color, but which do not have the same properties—farm machine reds, they are sometimes called. They are made by staining white inert pig-

ments like barytes with coal tar reds. And sometimes dull reds, like iron oxides, are stained with coal tar reds to gain the brilliant hue.

Until recent years blue lead has not been urged for metal painting. In a general way the manufacture of blue lead is quite like the manufacture of zinc oxide. The raw material is lead metal made from galena ore—precisely the same raw material as that from which white lead is made by chemical corrosion.

Dry blue lead is used in the manufacture of rubber and of prepared paints. Blue lead is mixed and ground to paste form with 90 parts of lead to 10 parts of linseed oil—or ninety per cent blue lead and ten per cent of linseed oil.

Other characteristics of blue lead as set forth by its manufacturers are:

It provides the two most essential qualities needed for protection of iron and steel—chemical action tending to inhibit or hold back the corrosive, rusting process and mechanical action tending to exclude air and moisture which cause rust. Blue lead doesn't harden in the container when mixed with oil. It remains in suspension—the pigment doesn't settle to the bottom of the pot, being exceptionally and uniformly fine it makes a paint film which attaches firmly and permanently to metal surfaces.

Blue lead is ground in pure linseed oil and packed in steel kegs of 12½, 25, 50 and 100 pounds, net weight. It is sold at the same price as white lead.

Because of the uniformity with which it spreads and the intensity of its slate gray color, blue lead has remarkable hiding power. A gallon of properly mixed blue lead in oil will cover approximately 800 square feet on surfaces of average smoothness. This figure holds good even when the paint is applied over pure white surfaces, which, as every practical painter knows, is the most difficult color to obscure.

The natural color of blue lead in oil is slate gray. It can be mixed with other materials, such as chrome green, chrome yellow, red lead, etc., to obtain a variety of colors, without appreciably changing its remarkable rust-proofing qualities.

MIXING FORMULAS—BLUE LEAD

100 lbs. of blue lead paste bulks 3 gallons, about the same as white lead;—

1 pound of blue lead paste bulks .018 gallon.

Surfaces which become too hot for the use of linseed oil may be coated with blue lead mixed with fish oil. Three coats are needed for rust-proofing metal surfaces. Blue lead in oil paste may be thinned with either boiled or raw linseed oil. When raw oil is used not more than five per cent (by weight) of japan drier is needed.

SLATE GRAY BLUE LEAD PAINT

100 lbs. blue lead paste
4 gal. raw linseed oil
1 qt. turpentine
1 qt. japan drier
Makes about 7½ gal. of paint

or

25 lbs. blue lead paste
1 gal. raw linseed oil
½ pt. turpentine
½ pt. japan drier
Makes about 1⅞ gal. of paint
Weight per gallon 19½ lbs

DARK GREEN BLUE LEAD PAINT

80 lbs. blue lead paste
20 lbs. medium chrome yellow
4 gal. raw linseed oil
1 qt. turpentine
1 qt. japan drier

Makes about 7½ gal. of paint

DARK BROWN BLUE LEAD PAINT

50 lbs. blue lead paste
50 lbs. red lead
4 gal. raw linseed oil
1 qt. turpentine
1 qt. japan drier (if 100% pure red lead is used)
Makes about 7½ gal. of paint

LIGHT GREEN BLUE LEAD PAINT

50 lbs. blue lead paste
50 lbs. medium chrome green
4 gal. raw linseed oil
1 qt. turpentine
1 qt. japan drier
Makes about 7½ gal. of paint

Graphite.—Natural graphite, a form of carbon mined from the earth, is a black and fine pigment having a metallic sheen. It is also called black lead and plumbago. This is a decomposed stone which in some instances may contain as much as eighty-five per cent graphite and a remainder of silicious material. The manufacturing process is principally one of mining, cleaning and separating the graphite from impurities to recover the soft dry pigment.

Graphite pigment varies in color from jet black to grays but is always too dark for general painting purposes. It is very durable and serves many purposes including the making of lead pencils, as a lubricant with grease for heavy machine moving parts and as a paint for metal roofs, structural iron, bridges and machinery in general.

Graphite paints are usually factory made to contain not more than forty per cent graphite, the other sixty per cent being silica or a mixture of other pigments.

Coloring matter is also added to make what are called brown, green or red graphite paints. Linseed oil is used as the vehicle.

An artificial graphite of extremely fine texture is also made. A graphite paint formula commonly used reads:

"This paint shall contain forty per cent pigment and sixty per cent liquids.

"The pigment portion shall consist of either the natural or artificial form of graphite. There shall be at least sixty per cent of graphite carbon in the pigment portion; the balance to consist of iron oxide, silica or silicious earth pigments.

"The liquids shall consist of eighty per cent pure linseed oil and twenty per cent combined thinner and drier. The thinner shall consist of equal parts by weight of mineral spirits and turpentine."

While graphite has been extensively used for metal paints for some years, some authorities now believe that it should never be used on bare iron and steel, that the first coat put on to such metal surfaces should be a rust inhibitive material. Over such a first coat graphite makes a valuable and durable protective coating.

One theory as to the cause of corrosion of iron and steel is that of electrolysis. Stray currents of electricity, leakage from high power lines, tend to liquify the metal surface; moisture and contact with the air oxidize or rust the liquid metal. To retard this electric action, paint coatings which are non-conductors are essential. Paint pigments like graphite, carbon black and lamp black are excellent conductors of electricity and so actually speed the corrosive action on iron and steel. This point was well stated by Dr. A. H. Sabin before the Engineering Society of Western Pennsylvania in these words:—

"The conducting power of graphite is so perfect that in electroplating plaster casts and the like, they are

covered with a graphite film not more than 1/10,000 of an inch in thickness, which conducts the feeblest current of electricity as though it were a metal surface. On the other hand a film of red lead paint has been found by electrical experts to be equal in inhibiting power to India rubber."

Aluminum Bronze Paints.—For certain kinds of metal surfaces aluminum paints possess an exceedingly valuable characteristic,—the ability to reflect light and heat rays to a greater degree than other paints. When it comes to painting oil storage tanks, gas holders, refrigerator cars and many other structures it is possible to make the paint assist in keeping the surface cool. Bronze paint is used on balloon and airship fabrics to deflect the heat rays and light rays from the sun which destroy the fabric unprotected in this manner rather rapidly.

The mixing of aluminum paint is accomplished in a reverse manner to that used for other paints, in the respect that the dry aluminum or colored bronze pigments are poured into a pot containing liquid. It is easier to mix any dry pigment with a liquid by placing the liquid in the pot first and stirring the dry pigment into it than if the reverse operation is followed.

The metallic pigments are very heavy and they settle to the bottom of the pot quickly. They should not only be thoroughly mixed, but it is essential to agitate the paint every few minutes by stirring in order to keep the paint of the same consistency all the time.

Aluminum paint should be mixed for average surfaces in the proportion of about 1½ to 2 pounds of dry aluminum powder to 1 gallon of heavy-bodied boiled linseed oil. This will make approximately 1⅛ gallons of paint.

For some purposes the liquid used is entirely special heavy-bodied boiled linseed oil. Ordinary raw linseed oil is too thin for use with this pigment. Some brands of heavy-bodied boiled linseed oil can be thinned with

turpentine or mineral spirits in the portion of 40 parts oil to 60 parts of turpentine and the resulting mixture will be of just about the right consistency for aluminum paint.

Where aluminum paint is exposed to the weather, spar varnish makes an excellent vehicle with which to mix the aluminum powder in the proportion of 1½ to 2 pounds of powder to a gallon of varnish. If the varnish vehicle is too expensive an excellent and serviceable liquid can still be made by using 20 per cent of ordinary pure raw or boiled linseed oil to 60 per cent of spar varnish.

The pigment particles of aluminum are flat and make up a paint film by a leafy formation, one flat pigment particle overlapping the other like fish scales. This leafy peculiarity retards the drying of linseed oil somewhat, and for that reason boiled oil is preferred. It is sometimes necessary to add a little japan drier to make the paint dry rapidly enough. And if a harder paint film is wanted, spar varnish should be added to the oil vehicle.

Aluminum paint is very opaque and protects a surface well. It is particularly noted for excluding ultra-violet light rays. Such paint is valuable for protecting not only metal but also surfaces which are subjected to both indoor and outdoor exposure. Aluminum paint reflects most of the light and heat cast upon it and absorbs very little. It is for this reason that aluminum paint is used as a protective medium on balloon fabrics. In past years the large gas bags of airships deteriorated rapidly because of the effect of the direct rays of sunlight. Aluminum paint has materially increased the life of such fabrics by excluding the heat and light. China wood oil is used with aluminum powder for such paints because of its ability to withstand high temperatures.

For use on exterior surfaces at least two coats of aluminum paint are necessary.

Aluminum paint should be fresh each day, because it deteriorates by losing its rapid leafing quality when it stands in the vehicle for some time.

The polished aluminum powder has a higher reflectivity than an unpolished aluminum. The polished pigment reflects between 55 and 70 per cent of light rays, while the unpolished reflects between 45 and 50 per cent of light rays.

It is interesting to note that some very pleasing decorative effects can be gained by mixing tinting color pigments with aluminum paint. The aluminum will conceal small amounts of color, but fairly large amounts will add their color to the paint, while the aluminum adds reflection and brilliance which are very pleasing.

Asphaltum Paint.—Asphaltum (bitumen) is a mineral pitch or natural tar which is sometimes melted in a kettle and brushed on while hot to metal surfaces. A rather inconvenient method, to be sure.

Asphaltum varnish is used to some extent for coating exterior metal surfaces like rain gutters, pipe, porch and stair railings, etc. It is made by dissolving coal-tar pitch in coal-tar naphtha. Some varnishes of this type are made from prepared asphalt pitch, oil and spirit thinners.

A common formula for asphaltum paint, the one written into the specifications of the Equipment Division, Ordnance Department, U. S. Army, reads:

"This paint must be made on a high grade asphaltum base compounded with linseed oil and drier. It must contain not less than 10 gallons of pure linseed oil to 100 gallons of varnish. It must be reducible with naphtha and free from sediment and dirt. It must set to the touch in 90 minutes, and must dry hard to a black, lustrous film in less than 15 hours. When dry

and hard, it must not rub up by friction under the fingers. It must not flash under 85 degrees F. in a closed Abel tester."

American Vermilion (basic lead chromate).—As a metal paint this pigment is rated as the highest of all for its rust-inhibitive qualities. It is rather too expensive, however, to use generally as a metal paint, although before the advent of the coal tar reds it was so used on machinery. American vermilion is employed extensively as a tinting color. Its hue is brilliant and about the same color as English, French and Chinese vermilions. These latter pigments, however, are made on a sulphide of mercury base, while American vermilion is made on a lead base.

American vermilion is a rather coarsely crystalline pigment having great opacity or hiding power and tinting strength. Its brilliant color is fairly permanent, but it turns black in the presence of sulphur fumes from oil refineries, furnaces, etc., and it should not be mixed with pigments having a sulphur base,—such pigments as ultramarine blue, English vermilion, etc.

Para Red Vermilion.—A coal tar color now used extensively in the agricultural machinery manufacturing field. Each manufacturer's specifications are somewhat different for this metal paint, but the following is a common formula for such a red:

"The dry pigment shall consist of non-fading, organic para red precipitated upon a white base. The pigment shall contain at least 10 per cent of pure organic coloring matter, the balance to consist of barium sulphate. The pigment shall be ground to a stiff paste in pure, clear, raw linseed oil, in the proportion of 80 parts of pigment to 20 parts of oil. This paste shall break up readily on thinning. The color, shade, tone, fineness and covering power shall be satisfactory. It shall be resistant to excessive bleeding."

PREPARATION OF SURFACES

The importance of careful preparatory work on wood surfaces is generally appreciated, but too little attention is often given to preparing metal surfaces for painting. And yet there can be no doubt that considerable scaling of paint on such surfaces is due to spreading paint over metal which is more or less covered with rust, oil, grease, scale or dirt.

Paint cannot adhere permanently, nor prevent corrosion of metal surfaces, unless placed in intimate contact with the sound metal when the metal is dry. When metal covered with rust, dirt, grease or the mill scale, which forms on iron and steel by the heating processes during hot rolling or tempering work, are painted over they prevent the intimate contact of paint and metal necessary. Changes of temperature of the metal on outside exposure forces mill scales off while rust covered areas continue to corrode, eventually causing the paint to scale off.

Structural metal shapes and machine parts are usually drilled or punched with holes and in these processes oil is smeared on the metal. It can only be removed by wiping with benzine, by sandblasting or pickling methods used in factories but not commonly available to the painter.

Contrary to common conceptions metal surfaces are filled with minute pores which offer anchorage for the paint coatings. Examination of any metal with a magnifying glass reveals this fact. And even though pores in metal are much smaller than wood grain pores, it is important to remove all grease, dirt, rust and mill scale in order to give metal paints a fair opportunity to attach to the metal.

A perfectly prepared metal surface results only when the metal is bright and shining and when cleaned to that extent, especially with the sand-blast machine, the first

paint should follow immediately after the cleaning, in a matter of hours, to avoid the formation of new rust. On such a surface new rust starts to form with surprising speed.

While the perfectly prepared metal surface is as bright and shining as a new coin, it is not by any means practical to so prepare all metal to that extent. Structural steel, metal roofs, steel doors, window sash, storage tanks, fire escapes and similar surfaces are considered sufficiently prepared when all loose surface accumulations like grease, oil, dust, rust, mill scale, old scaling paint, etc., have been removed, even though such removal doesn't leave a bright and shining metal exposure.

Metal Cleaning Tools.—When very large areas of metal surfaces are to be prepared in the shop or out in the field on erected metal the sand-blast machine is the most effective means of getting the work done speedily and perfectly. Such machines drive sharp sand with compressed air through a hose and nozzle and rapidly cut off all surface accumulations whether on metal or stone or brick. Such machine equipment represents a considerable investment and the average painting contractor doesn't have sufficient use for this machinery to justify the large investment.

Other tools and hand operations are principally relied upon for preparing metal surfaces, although painting contractors can often sublet the preparatory work of cleaning large areas of metal with sand-blast to contractors who make a specialty of this sort of work and who have large machine equipment with which to do the work.

The steel wire brushes pictured in Plate 103, Chapter V, and several other shapes and sizes are used for cleaning various kinds of metal shapes. Steel brushes are especially effective for removing dry rust, but not rust scales.

Plate 120 illustrates two home made scrapers which are unequalled for effective and speedy work removing rust scales, flaky mill scales, scaling paint, asphaltum

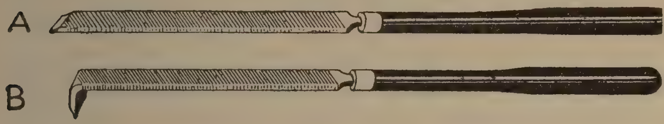

Plate 120.—Home Made Paint Scrapers

and other substances from structural and other steel and iron surfaces. These tools are easily made. Take a couple of old flat files—from ten to fourteen inches long—to a blacksmith. Have him turn the end of one file over about one and one-half inches from the end. Then grind a bevel or chisel edge on this and the other file as illustrated. The blacksmith will temper the steel to hard edges which will cut fast and long. Next have made a wood handle for each about a foot long so that two hands can grip the scraper at work. Short handles with ferrules on can also be secured from hardware stores and these serve well.

A hammer and cold chisel are needed for areas of heavy mill scale or large rust scales on deeply corroded places. After chipping off the scales use steel scrapers and finish with wire brushes or sand-blast.

Large and deeply rusted areas should be soaked with benzine, then burn off such areas with a match or go over them with a blow torch paint burner. After that treatment a steel wire brush is more effective in removing the dry rust.

Other tools needed for this cleaning work are plenty of No. 2 and No. 3 sandpaper, or steel wool, a duster brush—Plates 28 and 29,—an ordinary scraper, Plate 93 and sometimes a paint burner, Plates 90 and 91 for removing heavy spots of tar, grease, etc.

Some wiping rags, a can of benzine, or a mixture of benzine and turpentine are essential for the clean up work.

Hot water in which a little sal soda, washing soda, is dissolved is effective for washing many metal surfaces coated with oil or grease. If a strong soda solution is necessary the surface must be well washed later with clear water to remove every trace of soda which will destroy the paint. A coat of vinegar will neutralize the soda.

For those painters who specialize in industrial painting, and there are many who prefer factory work to house painting and decorating, new and effective tools are now available. In addition to the great savings of time and labor cost assured by the use of spray guns for painting large and rough surfaces, similar savings are to be made by using sand-blast machines, pneumatic air rust scaling hammers, acetylene paint burner torches and revolving steel wire brushes operated by compressed air or electricity.

Spray painting equipment is illustrated and described in Chapter III. The acetylene paint burners are illustrated in Chapter V.

Sand-Blast Machines.—Made in several sizes. One of the smaller types is pictured by Plate 121. Such machines are loaded with sharp sand. A compressed air pressure is built up in a storage tank by an air compressor driven by gasoline or by electric power. The sand is mixed with air at about sixty pounds pressure and is driven through a nozzle at the end of a rubber hose carried up to the work while the machine remains in the street or basement of the building. The blast of sand cuts off rust, dirt and old paint rapidly, leaving a bright, shiny metal surface which is perfect to receive paint. Sand-blast also cleans stone and brick surfaces in like manner.

Old hard paint is quickly removed from metal, stone,

concrete or brick by sand-blast, but paint on wood cannot be so removed because the sharp sand abrasive cuts into the wood fibre giving it a weather-beaten appearance. Soft paint simply gums up and is not removed by sand-blast, or at least it cuts off very slowly.

The investment for sand-blast machine equipment amounts to about the same as for spray gun painting outfits and of course the latter equipment can be used

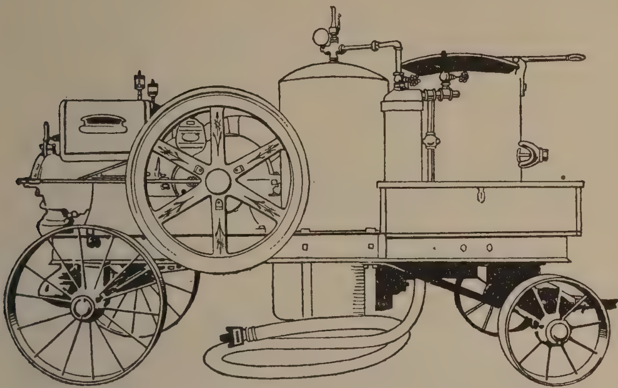

Plate 121.—Sand-Blast and Spray Painting Machine

for more purposes. When large areas of surfaces are to be prepared or a considerable volume of smaller surfaces are included in a contractor's work of preparation for painting the sand-blast machine soon pays its way. It is efficient, saves time and labor cost and prepares surfaces much better than can be approached by hand labor methods. In large shops steel railway cars, automobiles, ships and many items of small merchandise are quickly prepared for painting and repainting by sand-blast. The paint on an automobile, for instance, can be completely stripped off down to the bare metal in less than an hour with sand-blast, leaving a bright, clean surface.

Metal prepared with sand-blast and painted remains free from rust for a much longer period than when cleaned by hand methods. The sand blast machine will also supply air for spray gun painting.

Pneumatic Air Rust Scaling Hammers, Plate 122.—This tool is practically the same as pneumatic air riveting hammers but is of lighter weight and is fitted with a chisel edge tool. Similar tools are used for stone cutting and calking ship seams.

Compressed air is also required for this tool which

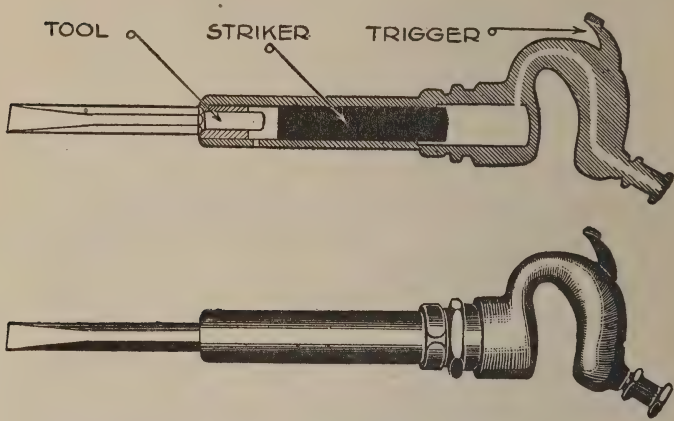

Plate 122.—Pneumatic Air Rust Scaling Hammer

is operated simply by pulling or pushing a trigger and holding the chisel point on to the rust scales and mill scales to be cut off. The air drives the chisel with repeated short, sharp blows as long as the thumb or finger holds the trigger down.

This air hammer will scale three or four times as much surface per day as can be scaled by hand with cold chisel and hammer on horizontal surfaces like plates, decks, bridge ties, beams etc. On vertical surfaces the weight of the pneumatic hammer slows down

production a bit, but still the work is easier and faster than hand work.

Revolving Steel Wire Brushes, Plate 123.—This air motor of the portable type was designed originally for grinding and buffing wheel operation. A steel wire brush when fitted to the revolving shaft which is driven by compressed air makes one of the most effective tools known for removing rust and dirt from metal surfaces. The brush revolves at very high speed and cuts old paint off as well as rust and dirt. The air exhaust from the air motor blows the rust, dust or old paint away.

The same type of revolving brush is made to be driven by a small portable electric motor and is more convenient for many where electric power is available and where compressed air equipment is not at hand. This tool is identical with the portable steel drills now used by all machine shops, garages, etc.

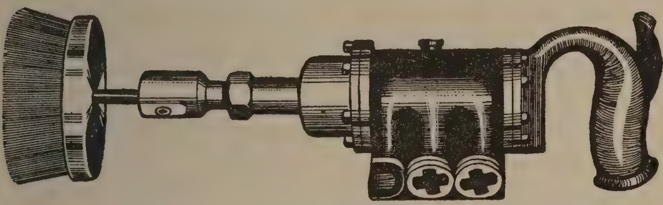

Plate 123.—Revolving Steel Wire Brush

Still another type of machine which does the same work has the electric motor mounted on a small truck with wheels on it. A long flexible wire cable in a hose housing has the revolving brush secured to the end, considerably like the dentist's drill.

Iron and Steel Surfaces.—What has just been written about the preparation of surfaces in general applies in particular to iron and steel preparation.

New steel structural shapes, doors, window sash, fire escapes, etc., usually receive one shop coat of paint. Such coats should be composed of very good paint, but

sometimes are of the cheapest and poorest paint. The first coat of paint on any surface is the foundation for all future painting. When the first coat fails to attach itself, scaling is quite certain to occur in the future. The first coat next to the metal should be the best of paint of the rust inhibitive type in order to hold back rust formation induced by electrolysis and also in order to form a firmly attached foundation.

New metal for interior exposure is sufficiently protected with two coats of paint, as a rule two coats are used but some authorities believe that interior metal surfaces are exposed to just as severe service and wear as exterior surfaces and they recommend three coats for interior as well as for exterior.

The second and third coats of paint on metal are usually tinted a little different than the preceding coat, just enough to distinguish one coat from another, thus making brushing of each coat easier, making certain that all surface is covered uniformly and making inspection easier.

Old metal surfaces usually require two coats of paint after they have been carefully brushed down to remove any scales, rust, dirt, etc. Grease and oil must be wiped off clean with benzine. Bare spots which appear after cleaning should be touched up with a coat of paint which should be allowed to dry before the two succeeding coats are put on to the whole surface.

In the preparation of old surfaces especial care should be taken to remove rust, dirt and grease from rivet and bolt heads. Rust usually gets a start at these points and upon edges of plates.

Old surfaces from which the paint is scaling generally require more thorough preparation. As long as the old paint is firmly attached to the metal over most of the area, showing scales only here and there, it is usually a firm foundation for new paint after removing the patches of scaled paint and touching up the bare

metal. But when so much of the total area of paint has scales in evidence as to indicate that scaling is general the whole paint foundation has an insecure attachment to the metal. In such cases every inch of the old paint should be removed down to the metal to give the new paint an opportunity to anchor itself on the bare metal. No paint job is any better than its weakest link,—the priming coat.

Removing old cracked and scaled paint is done with steel scrapers, by sandpapering, by burning with gasoline or acetylene torches or by the use of the sand-blast machine.

Galvanized Iron Surfaces.—The scaling of paint on galvanized iron so much in evidence is often due to the inability of even good paint to gain anchorage on the surface. The galvanizing process leaves an exceedingly smooth surface to which it is sometimes impossible for paint to attach itself. The use of the following washes will rough up the surface enough to allow the paint to attach itself:

> 4 ounces of copper acetate, copper chloride or copper sulphate dissolved in one gallon of water.

Or another suitable wash may be mixed this way:

> 1 qt. warm water
> ½ ounce nitrate of copper
> ½ chloride of copper
> ½ ounce sal ammoniac
> Mix the wash in a glass or earthen jar and then add ½ ounce of crude hydrochloric acid.
> Apply the wash with an old flat brush. The white powder which forms when the solution is dry should be brushed off before painting. The metal will be black when this wash has been applied and is dry.

Galvanized iron which has been subjected to the

weather a year or so doesn't need any wash when good paint is used.

Tin Plate Surfaces.—Sheet iron plated with tin solutions for use on roof decks principally require painting. Neither tin coated nor galvanized metal surfaces are proof against rusting because the slightest imperfection in the coatings offers a starting point for rust and soon a hole is rusted through the thin metal, even before the corrosion is detected.

Two thin coats of paint on metal roofs with at least a week between coats for drying make a good foundation. Then a third coat put on two or three weeks later will make a first class and durable job.

Tin surfaces should be wiped clean and dry with a cloth or cotton waste wet with benzine or turpentine just before painting. Also all rosin and acid stains at seams and joints left by the soldering should be scraped and cleaned well.

Hot water to which sal soda, washing soda, has been added is a good cleaner for tin. One pound of soda to five gallons of water is about the correct strength. Rinse the roof well with clear water and let it dry completely after the soda wash and before painting. Get the soda water out of seams and crevices certainly.

Zinc and Copper Surfaces.—These metals are not so often painted. They do not need paint for protection, since they do not rust. Roof gutters, decks, down spouts, etc. of zinc and copper are painted sometimes, however, to make them conform to the color scheme, or to prevent the green deposit which accumulates on copper from washing down and staining the painted walls below.

Before painting these metals it is necessary to wash and brush them to remove surface accumulations in the same manner as was described for preparing tin surfaces.

Copper is often given an oxidizing treatment to speed

the natural green patina which accumulates on copper with age. This process is given in Chapter XIX.

Two coats of paint are usually sufficient for these metals.

Number of Coats Needed.—Several thin coats of paint are always more durable than one or two thick coats because each coat becomes thoroughly dry and matures more quickly. But the time element enters and so it is commonly considered that three coats of paint are the best rust-proofing treatment.

The first, or shop coat, is put on in the factory where the structural iron or other metal is cut and shaped. Then two field coats are brushed on after the metal has been erected.

To enable an inspector to determine how many coats have been put on, and to help the painter cover the surface well, each coat should be tinted slightly different—for example, the first coat may be the natural color of red lead or blue lead, the second coat may be gray made by adding a little lamp black to the paint and the third coat may be green, dark gray, brown or black.

Brushing, Spraying and Dipping.—The success of rust-proofing paint coatings depends absolutely upon the man with the brush or spray gun. Thorough and conscientious brushing of the paint to make certain every inch of metal is covered is one great essential. Careful brushing to spread an even coating of paint and to cover every joint, rivet and bolt head is the requirement.

It is much easier to write this specification than it is to fulfill it. Many metal surfaces are painted from high and dangerous perches and where moving from stretch to stretch is precarious, indeed. Hence the temptation to slight the brushing. Inspection is difficult and at times impossible. So it's squarely up to the painter with the brush or spray gun to conscien-

tiously cover every square inch of surface or to realize that his carelessness causes very considerable losses of property and danger to lives by the rusting of steel supporting structures.

The kind of a brush preferred for metal painting is the round, or pound brush, or an oval brush. See Plate 20. Such a brush is better than a flat wall brush for most metal surfaces. With it the corners and small members can be more easily reached. It holds as much paint as the flat wall brush and a bit more pressure is exerted on it.

Spray guns are used now for a great deal of the painting on metal surfaces, especially for large areas like storage tanks, gas holders, roofs, etc. A great deal of time and labor cost are saved in this way.

For spraying mix your metal paint the same as for brushing, as to the proportion of pigment, oil and drier. Then thin the paint with benzine, gasoline or turpentine to the consistency which works best in your spray gun.

The dipping of metal parts in paint is often resorted to where the quantity, size and shapes of the pieces make it practical.

On structural steel the first coat, usually applied in the shop, should always be brushed on to assure the most permanent anchorage of the paint,—or the paint may be sprayed on and then brushed to lay it off.

Field coats on structural steel for new buildings sometimes are applied by dipping. Wood or preferably sheet iron tanks are used which are large enough to hold one piece of structural iron at a time. These are taken to the job. The large steel members are often too heavy to be handled for dipping and must be brush coated, but the smaller tie members of steel which are most numerous can be quickly dipped and piled up to dry before the structural iron workers hoist and rivet them into place.

When one of the two field coats is dipped it is best to coat the new rivets by brush before the last coat of paint is brushed or sprayed on.

Colors for Storage Tanks.—Large tanks exposed to the direct rays of the sun and the weather are usually painted dark colors, but this practice is lacking in good judgment when the tanks contain light, volatile liquids like benzine, alcohol, gasoline, benzol, turpentine, etc. The color of the paint on the outside of tanks is an influential factor toward establishing the temperature of the tank metal and the contents. And, of course, the hotter the tank the greater the loss of its contents by evaporation.

In this connection a study of the influence of color on tank temperatures is interesting. H. A. Gardner gives the following results in "Light-Reflecting Values of White and Colored Pigments":—

The rise in temperature of benzine contained in small tanks painted in the below colors with a gloss finish is indicated after each color. The tanks were exposed to the rays of a carbon arc light for 15 minutes for each color—

	Rise in Degrees F.
Tin Plate	19.8
Aluminum Paint	20.5
White Paint	22.5
Light Cream Paint	23.0
Light Pink	23.7
Light Blue	24.3
Light Gray	26.3
Light Green	26.6
Red Iron Oxide Paint	29.7
Dark Prussian Blue Paint	36.7
Dark Chrome Green Paint	39.9
Black Paint	54.0

A study of this subject leads to the deduction that

dark colored paints absorb heat rays to a greater extent than light colors and so increase tank temperatures, causing greater losses of volatile tank contents stored therein than when white and light tints are used for painting the outsides of the tanks. Flat finishes also absorb more heat than gloss. So it is apparent that white and light colors with a gloss finish are best for such storage tank surfaces.

Tanks containing acids which destroy ordinary paints should be coated with one of the acid proof prepared paints on the market. Ordinary paints for metal and wood will not wear long when acids are spilled on them or when subjected to strong fumes from certain acids.

CHAPTER XI

CEMENT AND BRICK PAINTS AND PAINTING

The thought of painting concrete, cement and brick surfaces to increase their life is not at all common. Such surfaces are often painted but we take it for granted that it is simply for decoration.

These surfaces are more or less porous. Water gets into the structure. The water freezes and the expanding of the ice gradually expands the size of each little pore or crack. Then more moisture gets in and freezing again the cracks are made larger. The process continues from year to year until large cracks appear in cement. Brick under the same evolution casts off chips and some of the bricks crumble away. So it is evident that these surfaces require painting for protection as well as for decoration.

Buildings constructed of steel encased in concrete are especially in need of painting both the steel and the concrete to waterproof the cement. The destruction of such steel by rust is promoted by electrolysis which simply means the travel of electrical currents which leak from high voltage lines on the surface of the steel. When the steel is damp or is covered with paint which is a good conductor of electricity—a rust stimulative paint instead of a rust inhibitive paint, corrosion proceeds continually. As long as the concrete is unprotected by waterproof foundations and by paint coatings above ground it will gather moisture and keep the steel moist, favoring rust formation. The steel should be painted with red lead or some other good

rust inhibitive paint like blue lead or one of the prepared paints made for this purpose and such paint should be mixed to dry flat or semi-flat so that the wet cement when poured into place around the painted steel will bond and attach itself firmly to the paint. A high gloss paint prevents proper bonding of the cement with the steel. Also the paint must be very dry. With the steel properly painted the next requirement is to paint the concrete to keep out moisture.

Suitable Paints.—There are on the market a number of high grade prepared paints made especially for use on cement, concrete and brick surfaces. They are worth the consideration of all who paint these surfaces. They are made with waterproofing oils, but otherwise are much like ordinary exterior paints. It is claimed for some of these special paints that they are not only waterproof but also proof against oil, gas, grease, acid, steam and stains.

Neutralizing New Cement.—Although cement and concrete sets hard enough in a few days to carry a load the maturing process goes on for a long time. When the material is fully mature the surface outside which has been exposed to the weather becomes neutral,—that is, there is no longer any active cement or alkali on the surface which will burn paint spread over it.

So when new cement and concrete surfaces are to be painted before they are a year old in the weather, steps should be taken to neutralize the active surface by treatment. For this purpose the best method known is to brush on to it a saturated solution of zinc sulphate in water. Such a solution is made by dissolving 3 or 4 pounds of zinc sulphate crystals in a gallon of water. This is then put on to the surface liberally with brushes or better yet with spray guns which perform the work quickly. The surface must then be allowed to dry a day or two before proceeding with the paint.

When paint is put on to surfaces where it is subjected

to active free lime this alkali changes the oil to soap and the rain water soon washes the soap off, leaving the pigment on the surface without anything to bind it together and attach it to the surface. Naturally, then, the pigment too gradually washes off. The free lime also has a damaging effect on certain colors which fade or change in its presence.

The zinc sulphate treatment is not needed on old cement surfaces to neutralize them, but the wash is worth while anyway because it fills the pores and stops suction to a great extent, thus saving the amount of paint needed.

Preparing Old Cement Surfaces.—The first precaution is to make sure that the surface is as dry as possible before painting. Then it is only necessary to brush down the surface with a broom to remove any loose sand or other accumulations and it is ready to paint.

When old surfaces of this kind have been painted before and some of the paint is scaling in patches it is necessary to remove such loose paint scales, with steel wire brushes usually.

Mixing the Paint.—For such surfaces as cement, concrete and brick the first coat should contain quite a little more oil (and enough turpentine to make the paint dry semi-flat) than is needed for second and third coats. Usually lead paint will be mixed about right if you follow the proportions given for new exterior wood painting in Chapter VI.

When using prepared factory-made paints follow the manufacturer's directions to the letter. Usually such directions require that you add from a pint to a quart of turpentine and linseed oil—equal parts of each—to each gallon of the paint used for the first coat on new surfaces. Second and third coats are spread on just as the paint comes from the container.

The covering capacity of paint on rough concrete

and cement and brick surfaces depends upon the roughness, porosity and moisture condition of the surface as well as upon how much the paint is brushed out. As an average it is safe to figure that one gallon will cover from 250 to 350 square feet of such surface.

Brushing the Paint.—There is nothing special about coating these surfaces with paint in the nature of brushing. Use old brushes because the rough nature of cement, concrete and brick surfaces rapidly destroys the bristles in good brushes. Some prefer four or four and one-half inch flat wall brushes for this work while others like round or oval brushes. Coating such surfaces with paint is very hard work at best. The paint should be made as thin as possible and still have it cover and hide the surface well. This kind of work is best done with spray guns.

Spraying the Paint.—For many reasons it is more satisfactory to apply paints and stains to rough surfaces like concrete, cement, brick, shingles, etc., with spray guns than with ordinary brushes. Such surfaces quickly wear off the bristles of brushes, the work of spreading the paint is very hard and is a slow process because much of the paint must be poked into place.

The use of spray guns for coating these surfaces saves a greater part of the labor cost and gets the job done in less time, because a first class spray gun outfit in the hands of a good operator will coat in from three to five times as much surface per day as can be done with one man using a common brush.

The amount of paint used by the spray gun figures from less to about 10 per cent more than would be used by brush painting, depending upon the skill and interest of the gun operator.

It is often possible to do such surfaces with only one coat sprayed on because the thickness of the paint film is under control and as much paint can be sprayed on

as is needed to hide the surface, as a rule, although if the paint has not the opacity of high class paints it will run before covering solidly in one coat. Although it is possible to spray on paint to a thickness which is equivalent to two or three brush coats, it is not always wise to do so. A well established principle in painting is that several thin coats dry harder and produce more durable coatings than a few thick coats. So it is usually preferred to spray on two coats to these rough surfaces when new. Old surfaces can usually be finished with one coat by the spray if the new paint is about the same color or darker than the old surface.

As a rule less scaffolding is needed for spray painting, although to gain speed in coating a surface so the spray gun equipment can be hurried away to another job, even more equipment than is used on brush coated jobs is often found profitable. With the spray gun it is not necessary to get as comfortably near many surfaces as with a brush, and the spray gun has a long extension handle which saves much scaffolding under some conditions.

Cement Floors.—Such floors as are made by mixing sodium silicate hardeners with the cement are strongly alkaline. They should be scrubbed with a hydrochloric acid and water solution—(5 parts acid to 95 parts water). Next wash the floor clean with clear water to remove every trace of acid. Let the surface dry thoroughly before painting or varnishing. Use rubber gloves in handling the acid and do not breathe the fumes from the strong acid; it is injurious. After a cement floor has been neutralized it may be painted in the regular manner with floor paints made or mixed for wood floors.

In some of the hospitals cement floors are treated with hot paraffin wax. After scrubbing thoroughly and allowing the floors to dry, the wax is put into a wash boiler and heated to the boiling point. The heating

must be done near the floor because the wax doesn't penetrate unless put on very hot. The wax is spread with a large brush. Two or three coats put on leaves a fair gloss and the floor is not slippery. It is easy to clean.

New Brick Surfaces.—A great deal of common yellow and white brick is being used now for residence construction and some of these surfaces are being painted or stained. As a rule the only preparation given these new surfaces is to brush them down vigorously with a stiff broom to remove all sand and loose mortar.

The paints which are suitable for brick surfaces are those which are in common use for cement, concrete and wood surfaces—both prepared and painter-mixed paints are used.

Flat brick red is most extensively used in some of the eastern states where old brick houses are much in evidence. There is little reason for selecting this gloomy color except that it has always been done and the paint is cheap and durable. The paint is usually mixed in these proportions:

First Coat—New Brick

80 lbs. Venetian red
20 lbs. white lead
5 gal. boiled linseed oil
1 gal. turpentine
Makes about 11 gallons of paint

Finishing Coat—Semi-Flat

100 lbs. Venetian red
3 gal. boiled linseed oil
2 gal. turpentine
Makes about 11 gallons of paint

A brick red as used in some sections is mixed this way:—

4 lbs. white lead
2 lbs. Venetian red
1 lb. Indian red

When white lead paint is to be mixed for brick surfaces the following proportions are about right, although some surfaces of this kind are more porous than others and so require more oil:—

First Coat

100 lbs. white lead
4 gal. pure boiled linseed oil
1 gal. turpentine
Makes about 7¾ gallons of paint

Second Coat

100 lbs. white lead
4 gal. pure boiled linseed oil
1 pint turpentine
Makes about 6¾ gallons of paint

Third Coat

Use same mixture as for second coat.

Old Brick Surfaces.—The preparatory work on these surfaces usually amounts to no more than brushing them down with a broom to remove all loose dirt.

Cracked and scaled paint on brick walls is very commonly found and it is always a problem to decide what to do about it. When the scaling is in evidence only in patches, small areas here and there, it is reasonable to believe that most of the paint on the walls is firmly attached. Then only the scaling paint on these few small patches is removed by scraping and sandpapering. The bare spots are touched up with a coat of paint before a coat is spread over the entire surface, which means an extra coat of paint on the bare spots.

But when the cracking and scaling of paint is general or the patches sufficiently numerous to make one

believe that all of the paint has an uncertain attachment on the surface, there is little to be done except to burn and scrape off all of the old paint so as to give your new paint a fair chance to attach itself to the brick. Otherwise the new paint would have to depend upon the very insecure foundation offered by the old paint,—it too would scale off in time under these circumstances. The method to pursue in burning and scraping off paint is described in Chapter XIV.

Staining Brick Surfaces.—Common brick being used considerably now for residences of the English cottage type of architecture and for large fireplace chimneys exposed on the outside of other styles of architecture is often stained white or a color. The staining is done in the common manner by brushing on regular shingle stains or by spraying these stains on to the brick. The stains in colors are mixed thin enough to color the surface without hiding the dark and light spots in the brick. In other words a mottled color blended effect is wanted, not a uniform color over the entire surface.

Brick Lining.—The liner brush illustrated in Plate 36, Chapter II is used for painting the brick mortar with black as a rule. A well trained hand at this needs no straightedge to follow the mortar joints with the flat black. The black paint is usually lamp black mixed with linseed oil and enough turpentine to make it dry without gloss. This lining is usually done on brick painted with the common flat brick red,—Venetian red.

Cleaning Brick Surfaces.—An efflorescence on brick, the white cloudy substance commonly known, may usually be removed when the greater part of the substance is calcium sulphate by washing and scrubbing the surface with a dilute solution of hydrochloric acid, —one part of strong acid to five parts of water. In some other cases the walls are washed with water containing about two pounds of laundry soap to a gallon

of water. After this a dish of water in which one pound of alum to the gallon is dissolved will clean up the accumulation.

Stains on brick are removed by various washes. Water stains usually can be removed by scrubbing with a wash made of one half pound of oxalic acid in a pail of hot water. Rub the surface stain with a piece of sandstone of fine texture or a lump of pumice stone or an artificial rubbing brick dipped into the water and acid wash. After this bleach, wash the surface well with clear water.

Soot and smoke stains can usually be washed off with warm water and soft soap or water and sal soda. Sometimes a paste is made of water, sal soda and whiting. It is smeared on wet and allowed to dry, then washed off and the surface is thoroughly washed with clear water before painting.

Marble and fine stone fronts can usually be cleaned by washing with water in which a little ammonia has been dissolved. Rub the surface with a lump of fine pumice stone or a rubbing brick soaked in the water.

CHAPTER XII

A STUDY OF WOODS AND SURFACES

A GOOD painter wants to know all about the character and the condition of the surface he is to paint before he mixes the paint or makes an estimate of the work to be done and the cost. There are great differences between both new and old surfaces, which not only call for more or less labor, but which alter the proportions of pigments and liquids and the relation of oil, turpentine and drier to the pigments.

Penetration and Anchorage of Paints.—When we look at a razor blade which is a very keen edge we get the impression of a straight line. But look at the same edge with a powerful magnifying glass and that sharp surface proves to be all cut up like the cutting edge of a carpenter's saw. And so it is with wood, metal, cement and other surfaces we paint. We think of them as solids, smooth and compact. As a matter of fact even the hardest of steel surfaces is filled with little pores which offer anchorage for paint.

Paint attaches itself to a surface by penetrating into the little pores, cracks and crevices and anchoring there. Turpentine and benzole aid this penetration. The deeper the penetration the more firmly attached the paint is and the more likely the paint will permanently adhere to the surface and make a good foundation for all future painting during the years to come. When these pores are clogged up with dirt, rust, old crumbling paint or an excess of sap, pitch or resin, as with pitch pine and cypress, paint has little oppor-

tunity to penetrate and anchor itself. Consequently the paint scales off. Perhaps not in a year; sometimes not until the surface has been painted a dozen years or more and has accumulated a thick paint film after the third or fourth painting. Then the weak attachment of the very first coat of paint is overcome by the excessive weight of the thick paint film and the paint cracks and scales off.

Expansion and Contraction of Surfaces.—All building materials expand at high temperatures and contract at low temperatures. Some surfaces expand and contract to a greater degree than others. In the light of these facts it is obvious that paint must be elastic enough to expand and contract with the surface it protects. Otherwise it will break when the surface gets hot. The rain will get into the breaks and soon the paint will be worked off in scales.

Linseed oil makes paint elastic. Turpentine and benzine decrease the elasticity of paint. Some varnishes and enamels are very elastic. The long oil varnishes like spar are very elastic. All finishing varnishes used outside must be elastic. Rubbing varnishes, on the other hand, are short,—they are hard and more or less brittle which is necessary to withstand the rubbing. Interior enamels are rather short and brittle to withstand rubbing and wear from abrasion. There is no need for great elasticity in these materials because the range of temperature differences in interiors is not great. Exterior enamels are made with greater elasticity because they must withstand the great range of temperatures from below zero to over one hundred degrees above in some localities.

Cracked and Scaled Paint.—Some old surfaces show small areas of scaling paint,—a board or two here and there. When such scaling is due to a moisture-soaked board, to a board or two loaded with pitch, the remedy before repainting is to simply scrape off such loose

scales, sandpaper down the rough edges of the paint, burn over with a paint burner torch to remove any excess of pitch or moisture and touch up the bare spots with a coat of paint before repainting the whole surface.

When great areas of a painted surface are covered with scaling paint, there is good reason to believe that the paint is at fault, being too hard and brittle to expand and contract with the wood during temperature changes, or that the last paint put on was spread over a priming coat of that nature. The preparatory treatment of such a surface sometimes amounts to no more than removing the paint scales, but that is only a postponement of the evil day. No painter can guarantee new paint against continued cracking and scaling when put on over old paint foundations of that character. The old paint continues to scale off and the new paint is prevented from gaining any anchorage for itself in the pores of the wood. The proper remedy is to remove every inch of the old paint before spreading the new. The most practical way to remove the old paint is to burn and scrape it off using a gasoline or acetylene torch, such as were illustrated in Plates 90 and 91. The method to pursue in the removal of the old paint is described in Chapter XIV.

Inspect Old Surfaces Carefully.—Study old paint on a house to determine if it was primed with yellow ochre. Look for spots that have been heavily coated and are ready to break loose when you put additional weight on them by spreading on more paint. Look for dampness from basements, drain pipes, down spouts and wet soil. Before you add more weight with new paint, see that dampness has not undermined the old paint and that the wood doesn't contain enough moisture to cause the new paint to break loose soon after the new job has been finished. If there are sources of moisture supply to the wood like leaky rain gutters, rusted out tin flashings over windows, dormers, etc., you cannot

make paint stick to the wood until these leaks are repaired.

Beware of loose scales, fine or powdered paint. Even if they do not look dangerous they will keep your new paint from anchoring in the pores of the wood. Mildew on a painted surface is usually proof that there is dampness in the wood. Paint put on over mildew will peel off. New paint put on over old paint which has shriveled is quite likely to break loose and scale off.

DESCRIPTIONS OF COMMON WOODS

An intimate knowledge of the structure and characteristics of each of the common woods which painters are called upon to paint is of great value. It is not enough to know the woods used years ago, because as the supplies of old woods become scarce, new varieties come on to the market. The painting of some of these newer woods requires special knowledge and understanding.

The very best way to learn the character of each kind of wood is to study unfinished samples of the woods. Get a board of each kind from the lumber yard or mill. Failing to secure all kinds write the lumber manufacturers' associations for sample panels. They will be glad to supply you with the samples and literature describing the woods. You will find advertisements published by the various lumber manufacturers' associations printed in many magazines. When you get the samples finish some of them to note how they become changed by staining, varnishing, filling, etc. Note how they absorb paint,—oil paint, flat paint, turpentine, etc.

Don't overlook the fact that the wood from a single tree differs in grain and color, depending upon whether the boards were cut from the outside or the heart of the tree.

Other points of interest and importance about woods

is to determine whether a sample is a hard, open grain, or a hard, close grain; soft, close grain or very soft, open grain; whether the wood is generally soft and spongy or compact and solid.

The permanence of a paint job is influenced, also, by whether the lumber has been kiln dried or air seasoned. When kiln dried too rapidly the wood may have become case hardened, and it is then brittle and lifeless. It has lost part of its strength. The paint for such wood must be mixed to a thin consistency and with enough turpentine or benzole to assure penetration through the case hardened area to a depth sufficient to reach the vital wood below it. Paint made heavy in consistency simply lies on the surface. And when the dead fibres of the case hardened surface break away by contraction and expansion of the wood with temperature changes, the paint scales off with it. Of course, such paint failures are charged against the painter and the paint. Air seasoned wood has lost none of its strength and vitality, so it affords a firm footing for paint.

Another circumstance which makes it necessary for painters to simply take a chance is that the lumber in a single house may represent many kinds of material,—some may be kiln dried, some air seasoned, some cut in the winter when the sap was down and some cut in the summer when the sap was up. Practically you cannot have a different kind of paint mixture to suit every kind of lumber, but a knowledge of these things often enables a painter to understand and explain paint failures, instead of being forced to take the blame, foot the bill and wonder himself why the job went wrong.

The necessity for mixing paint thin for some lumber in order to make it stick explains why it is impossible to do two-coat jobs which are durable. When the paint is made thin enough to penetrate it doesn't hide the

surface well enough to make a good looking job with only one more coat.

White Pine.—Although painters today are called upon to repaint many old buildings constructed of white pine, a new building put up with this lumber would be a rare sight in most localities. Supplies of this remarkable wood have dwindled to the point where it is too expensive to be used for any except special purposes like water tables on residences and some of the other trim boards. It is used for sash bars and to some extent for interior cabinet work, but for structural timbers and siding and sheathing white pine is a wood of the past on new structures.

Hard Pine.—This name is a bit indefinite since it refers to yellow pine, long leaf pine, short leaf pine, Georgia pine, Southern pine, Norway pine and pitch pine. All these woods are very similar and the names are different largely because the trees come from many localities. Of course there are real differences, technically, between these woods, but they are much alike for the purposes of painting.

As its name implies, hard pine is a hard, coarse-grained wood and the space between the open fibres is filled solidly with gum or sap. It is a heavy, tough, strong wood. The color is deep red in the sap streaks, but light yellow as a general color.

The first cut from the outside of the log, the sap wood, of this tree is real light yellow, while the middle and inside cuts of heartwood from the log are a reddish orange color. The sapwood is soft, open grained and it makes a good foundation for paint, since it allows pretty fair penetration.

The wood from the center of the log, the heartwood, is completely filled with resinous gum which offers very little opportunity for the paint to penetrate. Much scaling of paint is due to painting over this wood without an understanding of its require-

ments. This wood is difficult to season because the excess of sap prevents the moisture from evaporating.

The painting of hard pine surfaces is always a difficult thing to do because of the difficulty of gaining sufficient penetration and also because a building may have in it lumber which is very much mixed,—some soft and open grained and some very much filled with sap. When there are only a few boards here and there which appear to be excessively loaded with sap gum the best way to proceed is to get out your paint burning torch and scorch these pitch-streaked boards enough to boil some of the gum out and to rough up the smooth surface.

The mixing of paint for pitch-filled boards should include considerably more turpentine and less oil than for fairly absorbent woods, as much as half turpentine and half oil are necessary. In some sections the painters prefer to use benzole (160 degrees solvent naphtha) in place of turpentine with the oil. This benzole works about the same as turpentine and evaporates about as rapidly. It is a powerful solvent and will cut the gum and sap in the wood long enough to allow the oil and pigment to penetrate and anchor, then it will completely evaporate. Thin coats of paint well brushed in and out are an absolute necessity on this wood. Thick coats rich in oil often cause cracking and scaling of the paint. The grain figure or sap streaks of this wood are so dark that it is difficult to hide them with thin coats of paint, so three coats of paint are usually necessary to get a nice looking job.

The long leaf yellow pine tree is the one from which turpentine is extracted. The lumber from this tree retains much of the turpentine sap gum and when the sun beats down on such lumber this sap is apt to be drawn to the surface. Then the sap destroys the life of the oil in the paint which has been improperly mixed with too much oil and too little turpentine.

One safeguard in painting new lumber of this kind is to allow the building to stand in the weather a few months without paint. The sun and rain will draw out enough of the sap gum then to permit better penetration. The wood is also roughened up a little and that is an advantage because a rough surface holds more paint in place and permits white and light colors to hide the dark sap streaks more completely. The difficulty with this plan is that few home owners want to look at an unfinished house that long and that if good judgment is not shown too long an exposure will cause the soft, open grained boards in the building to open up at the joints, nail holes, etc. This lumber warps rather easily on exposure to the sun and rain.

For interior trim this kind of pine is usually finished simply by varnishing. It is sometimes stained attractively with brown stains, but will not take gray stains. The wood gets darker with age when finished in its natural color. It may be painted and enameled successfully when care is taken to use very little oil in the first coat and no oil in succeeding coats.

Poplar.—The other names for poplar are whitewood and yellow poplar. Poplar has had extensive use for clapboards or weatherboard siding on residences, but cypress is taking its place in some sections. It is a soft, clear, close and straight-grained wood which is not very elastic. It shrinks little on being seasoned, and while it is light in weight, it is strong enough for the purpose. One of the easiest of woods to paint, it has the ability to absorb paint, offering excellent penetration and anchorage. Not extensively used for interior trim but it makes an excellent foundation for white enamel finishes. It takes stain well but its grain figure is not very attractive.

Cypress.—A most enduring wood and one which is being used rather extensively for clapboard siding on building exteriors, for sash, doors, floors and many other purposes where the ability to stand up against

moisture and the weather generally is especially desired. Cypress is a close, straight grained, soft wood. The heartwood of the tree is rather a dark brown, while the sapwood is a yellowish white.

Cypress weatherboards, clapboard siding and similar cuts show great contrasts of color. When used for interior trim or for any purpose requiring a fairly uniform color in natural finish, cypress must be selected to gain some uniformity of color, the variations of color between sapwood and heartwood are great. Penetrating stains will even up the color differences, as a rule, however.

In dry kilns cypress acts badly and so most of it is seasoned by air drying. When well seasoned it doesn't shrink abnormally, nor does it swell and warp in the presence of moisture.

The painting of cypress while not difficult requires a bit of special knowledge and understanding of the nature of the wood. Because of the oily sap which permeates the wood, oil paint doesn't penetrate and gain sufficient anchorage unless mixed properly. The priming coat only of paint for cypress should be mixed to contain about 40 per cent of benzole (160 degrees solvent naphtha), 10 per cent turpentine and 50 per cent linseed oil. That would make your formula read about like this:

100 lbs. white lead
2½ gal. linseed oil
2 gal. benzole
1½ gal. turpentine
Makes 7¾ gallons of paint.

Benzole is one of the greatest penetrating solvents of resin, gums, grease, etc. It cuts into the oily sap of cypress and the gum resin of hard yellow pine, aids the paint pigment and oil to penetrate and gain anchorage and then the benzole evaporates completely.

Benzole works about like turpentine in the paint, evaporates about as quickly and is very inflammable. Great care must be taken to keep fire away from it. The paint must be well brushed in and out.

Benzole must never be used in any except the priming coats of paint. If used in a second or third coat it will soften up the under coats of paint.

Benzole is a coal tar naphtha, a by-product of gas works by distillation from gas tar. It is waterwhite and will freeze solid in low temperatures. It is sometimes used to rough-up old varnish coats which are to be painted over. A coat of benzole brushed on saves rubbing with sandpaper before painting. Benzole looks like benzine but has a decidedly different odor.

Douglas Fir.—This wood is also called Oregon Pine and is cut from giant trees which are made to furnish lumber for many purposes. The grain of fir is rather interesting and gives the appearance of watered silk. This is a light weight, strong, soft and close grained wood. It is porous enough to absorb considerable paint and offers a good foundation for painting and enameling. Its color is quite light. Fir is used for exterior surfaces, for timbers, sash, doors and for interior trim. It requires no filler for interior trim, stains well with oil and spirit stains. Water stains raise the grain considerably, too much to be smoothed with sandpaper.

Hemlock.—A wood which is quite extensively used for exterior construction. It is a coarse, rough, soft wood with open grain. When well seasoned it is light in weight and in color. It warps badly and splits. A pile of it in the hot sun will literally crawl all over the lot. The western hemlock is better as a rule than the eastern and middle-west product.

This wood is not as easy to paint well as some others. It absorbs the paint unevenly in spots and the paint upon it dries slowly. The paint must be well brushed

into the wood to gain good anchorage. Hemlock is not used for interior trim lumber.

Cottonwood.—Most of this wood is used for making paper pulp, but some is used for building construction. It is substituted for whitewood (poplar) but is not as good. Cottonwood is a close grained, compact, light-weight wood and is very soft indeed. The sapwood is nearly white while the heartwood is dark brown. This wood has little strength and warps to a considerable extent.

It is not difficult to paint this wood because it absorbs paint readily and offers good anchorage for it. It is so soft and porous, however, that extreme care must be taken to be sure it is dry, because it absorbs much moisture. When allowed to stand in the weather unpainted it molds, turns very dark and decays on the surface. In that condition it is a treacherous wood to paint, the wood fibres having little strength, the paint scales off as the wood on the surface crumbles away. Cottonwood is also subject to dry-rot. Sometimes when painted while wet, dry rot occurs under the paint causing the paint to scale off. So paint cottonwood only when absolutely dry, use plenty of oil and allow plenty of time for each coat to dry,—a week between coats is little enough.

Basswood.—This wood is also called linn and linden. It is a straight, close-grained wood, soft and compact in structure. Light in color and in weight and only moderately strong. It is used to a limited extent for building construction. Rather too soft. The painting of basswood is easily accomplished. It absorbs paint well, affording good anchorage and penetration. Mix the paint thin with both linseed oil and turpentine to secure penetration into the compact structure of the wood. Owing to the very light color and absence of prominent grain figure in this wood, it is easy to cover and hide with white paint.

Redwood.—A wood which is used rather extensively on the Pacific coast for both exterior and interior construction. It is light in weight, brittle, soft, coarse but close-grained wood. The grain structure is even and compact. It is a beautiful dark red in color and is without very prominent grain figures. An easy wood to paint because it absorbs paint readily offering good penetration and anchorage. Being dark in color, three coats are usually necessary to hide the red color. The paint should be mixed thin with the usual amount of oil and turpentine. Redwood used for interiors requires no filler. The varnish coats are sufficient to fill the wood which is usually finished in the natural red without stain. Redwood can be stained and it also is a substantial foundation for enamel finishing coats.

Cedar Woods.—Several kinds of cedar are used for various purposes in different localities. White cedar is used for exterior building construction rather extensively in some sections. A wood of light weight, soft, brittle, close grained and compact character. And of course all cedars are durable woods. The sapwood of white cedar is light in color while the heartwood is brown. An easy wood to paint because it absorbs paint well and offers good penetration and anchorage. Considerable oil is needed to satisfy suction. Use thin coats. White cedar takes stains well.

California and Oregon cedars are similar and are used for exterior construction. These woods are light in weight, soft, strong and durable. They are close grained and absorb paint well, offering good penetration and anchorage. At least three thin coats are needed and four coats of paint are much better in order to supply enough oil.

Red Cedar is used in a limited way for exterior lumber and extensively for making shingles,—the very best lumber for this purpose. Lead pencils are made from this wood. A light weight, soft, close, even grained

wood which is not very strong. The sapwood is white and the heartwood is red. Oil of cedar is made from this tree and that oil is a paint solvent. So unless the wood is well seasoned this oil will likely destroy the paint coatings. Red cedar doesn't absorb paint readily nor does it offer good penetration and anchorage. Paint dries slowly on it. Mix paint for it thin, with plenty of turpentine and allow plenty of time for each coat to dry. The dark color of the wood and the necessity for thin coats makes it imperative to use at least three coats on new wood.

Washington cedar is considered a soft wood, but the trees produce wood which is both soft and fairly hard. This wood is very close grained but is light in weight. It absorbs paint rather unevenly. Thin coats well brushed out and with a little more turpentine than usual are needed. Allow plenty of time for each coat to dry.

Chestnut.—This wood is so near to oak in the appearance of the grain figure that few can tell the difference. It is a light weight, coarse grained wood. It is open grained, of course, and is very durable. Chestnut is little used for exterior building construction and not to any great extent anywhere. Its open grain doesn't absorb paint as readily as might appear. The paint doesn't seem to penetrate. Mix paint thin with a liberal amount of turpentine and brush out each coat, allowing plenty of time to dry. Chestnut interior trim may be stained attractively and a filler is required when varnishing.

CHAPTER XIII

ESTIMATING MATERIALS REQUIRED

The subject of estimating in its broader meaning is far too large to be covered in detail and completely in one chapter. Estimating properly includes consideration not alone of methods for calculating materials required for a job, but also labor required, and the addition of overhead expense and profit. So the subject has been presented in another book ("Estimates, Costs, and Profits") where adequate space could be devoted to each phase of the problems.

There are, of course, many variations in the methods pursued by painters who estimate materials needed, who take off the quantities, as it is called. And no matter what method is followed many considerations are left for the estimator's judgment. Some rely upon measuring surfaces with rule or tape line more or less accurately, while others step off the distances. Still others who are older and experienced at the business merely look the room or house over and are able to tell rather accurately what will be required. Very rarely is it necessary to measure accurately any surface unless it is one of a great many which are exact duplicates and when the measure of one area is to be multiplied many times to get the total area of a large structure. Then a small error would be increased so many times that it would amount to considerable.

Taking off quantities from blue prints is identical with taking them from a finished building, except that the estimator must be able to read the blue print scales

and to visualize completed rooms from floor plans and detail sketches.

Figuring the amount of paint required is simply a matter of common arithmetic. It is a matter of multiplying width by height to arrive at the area in square feet. Then when the covering capacity of the paint is known in square feet you have simply to divide the total number of square feet in a building surface by 500

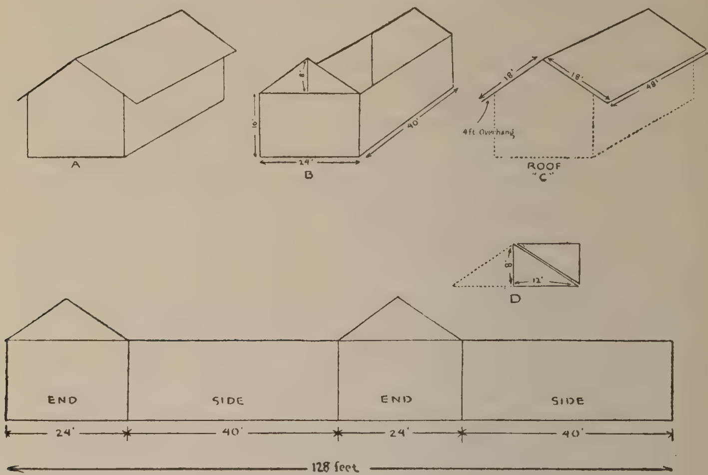

Plate 124.—Simple Building Outlines for Estimating

or 600 square feet (if that is what a gallon of your paint will cover) and the result is the number of gallons of paint needed.

Measuring Surfaces.—The very first step to take is to get into your mind a picture of the building in its very simple outline, its most simple form as indicated by Plate 124.

Take your first measure by starting at one corner of

the house and measuring the number of feet across to the next corner, then continue to the third corner and around the house back again to the point where you began.

The second step is to measure the distance from the bottom of the side wall to the top of the side wall up under the eaves of the roof. Indicated as 16 feet on Plate 124, "*B*". This does not include the gable.

Having the total distance around the house (24 plus 40 plus 24 plus 40 = 128) and the height to the top of the wall (16 feet), multiply one by the other, thus

> 16 feet x 128 feet = 2048 square feet, the area of the two sides and two ends.

To find the area of the gable ends multiply the height by one half of the width of the house. In the example "*B*" and "*D*" Plate 124, we have the width of the house as 24 feet and the height of the gable as 8 feet, so multiply thus,—

> 12 feet x 8 feet = 96 square feet as the area of one gable end. There are two ends, so double the area of one end and you have 192 square feet for the area of two gable ends.

To find the area of the roof is simply a matter of measuring, or estimating the measure based on the ground measure of the house. In the example "*C*," Plate 124, we have each pitch of the roof with a measure of 18 feet and the length of the roof is 48 feet. Note that the roof overhangs the house 4 feet on both sides and both ends which makes the roof 8 feet longer than the foundation of the house, and more than 8 feet wider than the foundation because the rise in the roof rafters lengthens them over what would be needed for a flat roof. So the calculation of the roof area is simply a matter of,—

18 feet plus 18 feet=36 feet.
36 feet x 48 feet=1728 square feet for the area of the roof.
Your total estimate for the building then would read,—

Two Ends and Two Sides..........	2048	square feet
Two Gable Ends	192	" "
Roof	1728	" "
	3968	square feet

is the total area of the house.

No account has been taken of window and door openings. The casings and mouldings of these will as a rule take as much paint as an equal area of solid surface, so allow no deductions for such openings. And of course it will take much more time to paint windows and doors than an equal area of plain surface.

Few buildings are as simple as the example given, but the buildings which have L-shaped wings can be figured as separate buildings, allowing only three sides, of course, because one side butts up to the main house.

The number of gallons of paint required to paint this surface is calculated by simply dividing the area of the surface by the number of square feet a gallon of the paint will cover. If a gallon of the paint you have will cover 600 sq. ft., one coat, the requirement is figured as follows:

3968 square feet divided by 600 square feet =6.613, or a little over 6½ gallons of paint for each coat.

Covering Capacity of Paints.—When the wit says that something is "as long as a string and as wide as a board," he gives almost as good an answer as can be given to the question as to how much surface a gallon of paint will cover.

The answer depends upon the paint, upon the color,

upon the surface and upon the man who brushes or sprays the paint. The thickness of the film spread, the absorption of the surface and the roughness of the surface govern, too.

Some paints have greater opacity and spreading power than others of the same color, due to the kind and quantity of basic pigments contained. White and light tints will cover less surface than black and dark colors. Dark colors will usually be spread out to a thinner film of paint than light colors, just because it is possible to do it easily.

White and light tints will cover a greater number of square feet per gallon when spread on top of light-colored wood, or old paint which is light in color, than when spread on black or dark, or dirty surfaces.

Any paint, light or dark, will cover more surface per gallon when spread on smooth surfaces, like iron and steel, than when spread on rough surfaces which catch and hold a thick film of paint, like brick and shingles, for instance. And any paint, light or dark, will cover more surface when that surface is hard and well filled, having little suction, than when dry, porous and absorbent.

The limit of spreading ability of paint is reached when that paint ceases to hide and cover the surface well. Pigments which are very opaque like white lead, titanium oxide, lithopone, zinc, lamp black, Venetian red, Prussian blue and some others can be spread out to a very thin film and still they will completely obscure the surface. On the other hand such pigments as silica, barytes, whiting, clay and a number of others must be spread in very thick films to hide the surface at all well. When dry these pigments look quite like the other white pigments, but as soon as they are mixed with oil they become rather transparent.

It is quite out of the question to strike an average statement as to the amount of surface one gallon of

paint will cover as between light colors and dark, first, second and third coats, new and old surfaces, rough and smooth surfaces. The facts in each case must determine the capacity of the paint. Perhaps the following statements of specific cases will be of assistance:

New Wood Surfaces.—For the priming coat, of white or light color, on woods which are soft and absorbent, like yellow and southern pine, one gallon of paint will usually cover well about 350 square feet, one coat. On hard pitch pine and similar non-absorbent woods a gallon of white and light tints will cover about 400 square feet, one coat. Tints and dark shades on the soft woods will cover from 400 to 500 square feet per gallon of paint. Tints and shades on hard, non-absorbent woods will cover up to 600 square feet per gallon, one coat.

Old Wood Surfaces.—When the old paint is very dry, is chalking considerably and is quite absorbent, a gallon of white and light-tinted paints will cover on an average about 500 to 600 square feet, one coat. When the old surface is weather-beaten, much less surface will be covered by a gallon of paint,—in some cases not over 250 to 350 square feet of such surface will be covered by a gallon of white or light tinted paint. Old surfaces which are well preserved and not unusually absorbent will be covered at the rate of about 650 square feet, one coat, per gallon of paint, when the new paint is not lighter in color than the old. When the old paint is lighter in color than the new, more surface per gallon will be covered,—and when the old paint is darker than the new, less surface will be covered. Shades and dark colors on old dry, porous painted surfaces will cover about 600 to 700 square feet per gallon, one coat. When the old paint is only normally absorbent and is not chalking excessively, shades and dark colors cover from 700 to 800 square feet per gallon, one coat. A gallon of

lamp black and oil paint here will cover up to 1000 square feet.

New Brick Surfaces.—On new, soft brick a gallon of white or light tints will cover from 100 to 150 square feet, one coat. Shades and dark colors will cover from 150 to 200 square feet, one coat. Hard pressed brick, when the joints are well made, will be covered at the rate of 350 square feet per gallon of white or light tinted paint, one coat. Shades and dark colors will cover up to 400 square feet per gallon, one coat on this surface.

Old Brick Surfaces.—Figure covering capacities on these about the same as for old wood surfaces, but allowing a little more paint for the rough mortar joints.

Cement Surfaces.—Some fairly rough cement surfaces will be covered with paint at about the same rate as soft brick. Very smooth cement surfaces may be figured the same as pressed brick. Rough and rugged stucco cement surfaces absorb or afford lodgment for a great deal of paint,—more will be required for brushing than for spraying on the surfaces. Depending upon the degree of roughness and porosity of the stucco, a gallon of white paint and light tints will cover about 100 square feet, one coat. Shades and dark colors will cover up to 150 or 200 square feet, one coat.

Metal Surfaces.—The nature of the metal surface has much to do with the covering capacity of a gallon of metal paint, and of course the disposition of the painter to brush it out thin or flow it on thick is all important. Paint spread upon structural iron, bridge members and similar iron will not cover as much surface as when the same paint is spread upon large steel tanks like gas holders, railroad tank cars and similar large areas. Reports of coverage on various surfaces are at considerable variance with each other. Here are such as will shed some light on what has been done in actual work:

The foreman painter of an eastern railroad reports red lead paint covers 650 square feet per gallon, one coat, when spread full. The United Gas Company, Philadelphia, using a heavy paint on steel gas holders, the very large tanks, reports coverage of 900 square feet per gallon of paint, one coat. Contractors who painted some Pennsylvania Railroad bridges report a coverage with red lead of 900 square feet per gallon, one coat. On new steel ship hulls the Maryland Steel Company reports a coverage of 840 square feet per gallon, one coat, with red lead paint, using it heavy. The Massachusetts Water Commission reports a coverage of 700 square feet per gallon, one coat, for red lead mixed on the basis of 33 lbs. of dry red lead to 1 gallon of linseed oil. Blue lead mixed in the proportion of 70 lbs. of pigments to 30 lbs. of oil and thinners is reported to cover from 600 to 800 square feet per gallon, one coat, on structural steel. Aluminum paint made in the proportion of from 1½ to 2 lbs of dry powder to 1 gallon of heavy bodied linseed oil, or twenty per cent to sixty per cent spar varnish with ordinary boiled linseed oil, is reported to cover from 600 to 900 square feet, one coat, per gallon on smooth metal. White lead paints and high grade, ready-mixed paints will cover more surface on metal than on wood, as much as 700 or 800 square feet per gallon, one coat, on some surfaces. On railroad steel tank cars one test reported determined that paint made of two-thirds white lead and one-third zinc, tinted with lamp black to a medium gray, and thinned with linseed oil, covered not to exceed 515 square feet when skilfully brushed out.

Shingle Stains.—For the average run of cedar shingles the following is a safe estimate:—1 gallon of stain covers about 100 square feet, one coat, when the stain is applied with a brush.

2½ to 3 gallons of stain covers 1000 shingles when they are dipped about eight inches into the stain.

3½ gallons of stain is enough for dipping and applying 1 brush coat to 1000 shingles.

Measuring Structural Iron Surfaces.—Probably the greater part of the estimating done on structural steel and bridge work is pure guess work after looking over the structure. The time required, the labor cost to do such jobs, necessarily remains largely a matter of making an intelligent guess, but to measure the surface area to be painted and to calculate the amount of

Plate 125.—The I-Beam Structural Steel Shape

material required can be done with reasonable accuracy.

The various steel manufacturers making structural steel shapes print and place in the hands of architects, engineers and building contractors data books called "shapes" books. They contain illustrations and tables

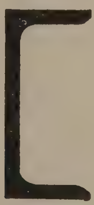

Plate 126.—Commonly Called a Channel Iron Made in Several Sizes

showing sizes, weights and all dimensions of the many standard structural steel shapes used in the construction of buildings, bridges, gas tanks, etc.

Plate 127.—Called Angle Iron. This Shape is Made in a Great Many Standard Sizes

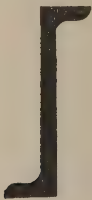

Plate 128.—The Z-Bar Used to Some Extent. The Surface Area Figures about the Same as the Channel Irons

From these books you can quickly learn the surface area per lineal foot of a 10-inch I-beam, for example. Then by simply measuring the total number of lineal feet of 10-inch I-beam to be painted you can quickly figure the area of the surface. Plate 125 pictures the I-beam shape, Plate 126 is the channel shape, Plate 127 is the angle and Plate 128 is called a Z-bar.

The shapes books can be purchased from any of the large steel manufacturers, or borrow a book from a friendly architect or engineer long enough to make a typewritten copy of these tables of areas and weights.

On new work the architect or engineer can give the painter the total weight of structural iron used, separated into each of the different shapes. Then if the painter will consult the tables of weights in the shapes book he can readily learn the number of pounds per foot for each shape.

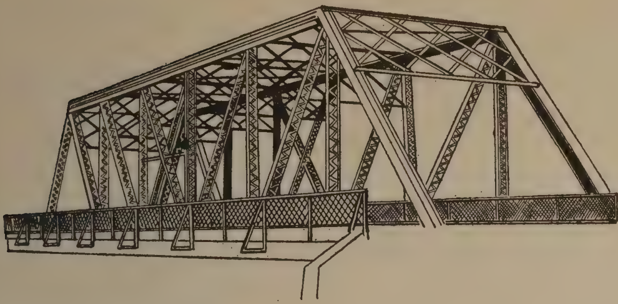

Plate 129.—Average Steel Bridge for Estimating

So, by dividing the total number of pounds of steel of each shape by the number of pounds per foot, he learns the number of lineal feet of steel on the job for each structural shape.

Now, with the number of lineal feet known and finding the area per foot from the table, the total area in square feet of surface to be painted can be quickly computed.

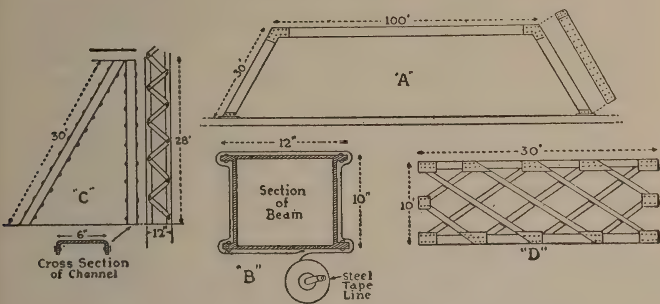

Plate 130.—Simple Forms of Bridge Units

Note the bridge in Plate 129. While every bridge and other iron structure is a problem in itself, this is rather an average type of bridge. If you will study it

a few minutes it will be evident that the structure is made up of a number of units which are repeated many times. So, if you will find the measure of one unit the total area of the steel in the whole bridge can be figured rapidly and accurately.

By reducing the bridge units to the simple forms indicated on Plate 130 the calculation is easy. The unit marked "*A*" represents the principal beams. It is not difficult to measure these. For illustration assume that the two end beams are each 30 feet long, while the top span is 100 feet. Then we have 160 lineal feet of beams. The other side of the bridge repeats this unit, so we have double the measure or 320 lineal feet of beams of this size.

If these beams are 12 inches on one side and 10 inches on the other the total measure around them will be approximately the sum of 12 and 10 and 12 and 10, plus at least two inches on each of the corners for the flanges through which the rivets pass. So we measure around the beam with a rule or steel tape, as indicated by "*B*," Plate 130, and find a total of 52 inches. 52 inches equals 4-1/3 feet. To figure the area of the beams is simple enough now. Consider them the same as a flat surface which is 4-1/3 feet wide and 320 feet long. Multiply 320x4-1/3 and the product is 1386-2/3 square feet of surface to be painted.

Note unit "*C*" in Plate 130. What area is left in the bridge is largely composed of these triangles. There are 6 on each side, or 12 triangles in all. These triangles are made up of channel iron riveted together with cross ties to form a lattice work on two sides of each beam. These lattice strips will require fully as much paint, and more time, to cover them than if the four sides of these beams were solid surface. For purposes of figuring the material consider these to be solid beams, which are 6 inches on one side and 12 inches on the other.

The measure around these beams in the triangle, then, will probably be 6 plus 12, plus 6 plus 12, which equals 36 inches. To this should be added the width of the flanges on all four corners at 2 inches each. So we have 36 inches plus 8 inches, making 44 inches around each beam. 44 inches is 3-2/3 feet. Now assume that one leg of this triangle is 28 feet high and the other is 30 feet high and we have a total of 58 lineal feet for each triangle. There are 12 triangles in the bridge, so we multiply 58 by 12 and find that there are in this whole structure 696 lineal feet of beam of this size. Each beam is 3-2/3 feet around, so we simply multiply 696x3-2/3 and find that the area of all these beams together is 2552 square feet.

Note unit "*D*" on Plate 130. On each end of the bridge, angle irons have been used to tie the main beam structures together. Assuming that the width of this bridge is 30 feet this truss of angle iron would figure up about this way:—

1 top angle 4x4 inches by 30 feet long, which is equivalent to a flat surface 8 inches wide, or 2/3 feet wide by 30 feet long making an area of.............	20 sq. ft.
1 bottom angle iron same size as top....	20 sq. ft.
3 angle irons 18 feet long and 2 angle irons 9 feet long on each side of this truss, making a total of 6 angles 18 feet long and 4 angles 9 feet long, or 144 lineal feet in all. This angle iron is probably 2x2 inches. A surface which is equal to 4 inches wide by 144 feet long, or 1/3 foot x 144 feet which equals 48 square feet. There is such a truss at each end of the bridge, so we have 2x48 or..........................	96 sq. ft.
	136 sq. ft.

The fence or safety rail on each side of the bridge is made of steel straps and is probably about 3 feet high and about 125 feet long on each side. The paint used on such a surface is fully equal to that used on a plain solid surface of the same dimensions, so figure it as a solid, or a surface 3 feet x 250 feet, which equals .... 750 sq. ft.

On the top of the bridge are a few angle iron trusses which can readily be computed by the same methods as have just been discussed. The total surface to be painted, then, with that exception and excepting also any steel which might be in use under the roadbed, would be set down as:—

Main beams Unit "A"	1386-2/3	sq. ft.
12 Triangle beams Unit "C"	2552	sq. ft.
2 End Trusses, Unit "D"	136	sq. ft.
2 Fences or Safety Rails	750	sq. ft.
Total.......	4324	sq. ft.

CHAPTER XIV

A JOB OF PAINTING WITH THE BRUSH

WHETHER the building to be painted is new or old the very first step in the procedure is to make an inspection of the building in general and the surface in particular.

If a new building study the lumber and decide whether it is soft and porous, having considerable ability to absorb paint, or a rather hard, compact sap-filled wood which will absorb little paint. Note whether most of the lumber is of the same kind, or whether some is soft and porous while other areas are hard and sap filled.

Is the lumber dry enough to paint? That point is very important. Is it covered with frost or dew in the morning and how long must you wait before the sun dries the surface frost or dew, making the wood safe to paint?

How about dirt, plaster or tar splashed on to the wood by other mechanics?

If the job is an old one, note the exact condition of the old paint. Is it firmly attached to the wood generally? If any scales of paint are to be seen, is it simply a local condition with patches of scales here and there, or is the scaling general? Is the paint which has not scaled firmly attached to the surface, or is all of the paint rather insecurely attached, making it necessary to remove all of the old paint to give the new paint a fair opportunity to attach itself to the wood?

If there are round blisters of paint here and there

of various sizes, were these blisters caused by the sun drawing excess sap from the wood? If they were evidently caused by moisture in the wood from other sources,—that is, if the wood is not excessively sappy in nature, then where did the moisture come from? Was it simply caused by painting over the wood when it was wet from rain or frost? Was the wood poorly seasoned before being painted the first time? Did the moisture get into the wood from leaking roof gutters, shingles or tin flashing over windows? Did it get in from leaking plumbing pipes? Regardless of where the moisture came from, is the wood dry now and has the source of the moisture been shut off?

Mixing and Tinting the Paint.—If the wood is new and of the pitch pine or cypress varieties, read the description of special treatment for these woods with benzole in the paint as given in Chapter XII. In Chapters VI. and VIII. will be found standard formulas for mixing the paint and other information concerning mixing. The tinting of the paint, the colors needed and the oil and thinners required are all described in Chapters VI., VII., VIII. and IX.

Scaffold Needed.—In Chapter IV. descriptions of all ladders and scaffold equipment in common use will be found for various types of buildings from the small cottage to the large public buildings.

Assuming that we are about to paint an average residence, such as is shown in Plate 131, the surface can be reached by the use of long ladders and extension ladders alone, but remember that a man can work more comfortably from plank platforms and that more and better painting will as a rule be done when working from the ground and from planks. It is wise to scaffold a job with enough equipment to encourage good work. So extension ladders from which brackets,—Plate 68, Chapter IV, are suspended to support planks, or some of the patented plank supports, are much better

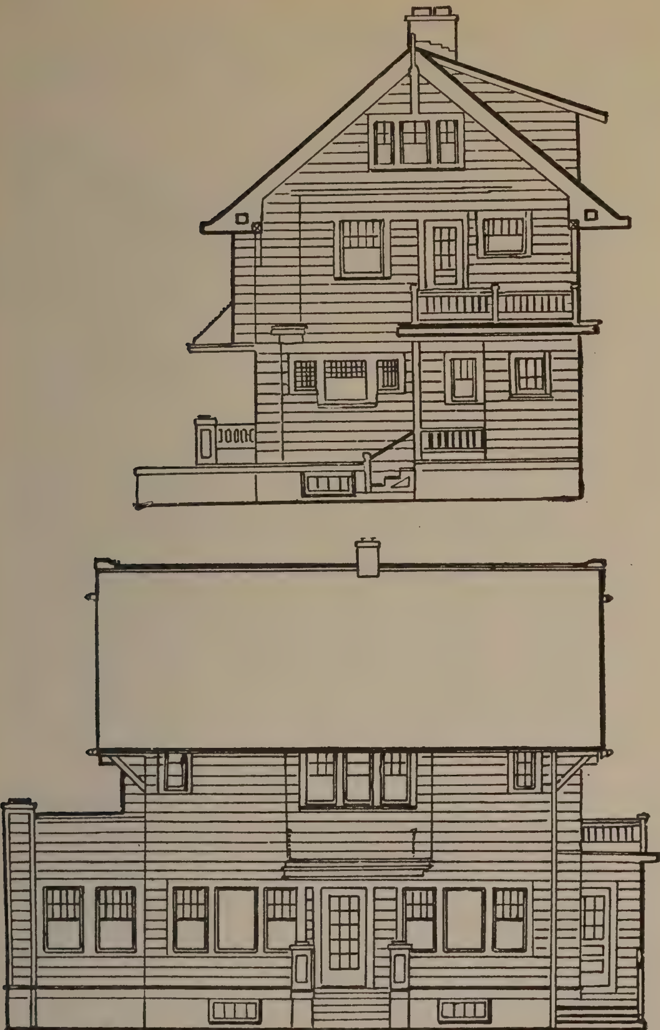

Plate 131.—An Average House to Be Painted

than to require a man to stand on the rung of a ladder for hours at a time. Then, too, a man will waste quite a little time moving ladders every few minutes to enable him to reach the surface.

On buildings of this type it will not pay to use swing stages. Extension ladders with planks for the upper surfaces and a couple of trestles with a plank for the lower wall surfaces will speed the work. Note the trestles and planks in Plate 57, Chapter IV.

Tools Needed.—In addition to the scaffold equipment needed for such a job, use will be found for the following tools:—

Drop Cloths to cover cement sidewalks, shrubs, etc.
1 Flat wall brush for each man, 4 inch or 4½ inch size.
1 or 2 flat or round sash tools for sash trimming and mouldings for each man.
1 Duster brush for each man.
1 Putty knife or broad scraper for each man.
6 Sheets of No. 1 or No. 2 sandpaper for each man.
Wiping rags to remove paint from window glass, etc.
I One gallon paint pail or an empty 50-lb. white lead pail for each man.
1 Wood mixing paddle for each man.
1 Large mixing paddle.
1 Mixing tub, half of a barrel is good.
Paint strainers
1 Paint burner, gasoline or acetylene gas.

Preparing the Surface.—If old paint must be removed because it is scaling generally, note what has been written in Chapter XII about surfaces and the preparation necessary. Also note in this chapter the directions about the method to follow in removing scaling paint.

New surfaces and old which are in good condition for painting require only a thorough dusting off to remove any loose particles of dirt on the surface. A few places here and there need scraping with the broad scraping knife and sandpapering to remove roughness or dirt or plaster, etc. Otherwise simply scrape off any loose paint scales and blisters, sand down the edges and dust off the whole surface with the duster brush.

Any new or old surface which is spotted with oil or grease from the hands of steamfitters or other mechanics should be washed with benzine, or the paint will not stick to such places.

Scorch and Shellac Knots.—Some of the lumber being used now shows quite a number of knots which are pretty well filled with pitch. The sun will draw this pitch out and cause yellow spots over each knot. Shellac is only fairly successful in holding back this pitch. The best treatment is to draw out some of the pitch by heating the knots with the flame from a paint burner torch, being very careful not to hold the torch on the knots long enough to make them take fire and burn. When the pitch has been drawn out and is cool scrape it off smooth. Now coat each knot with two thin coats of orange shellac. And some very careful painters will daub a brushful of paint over each before painting the whole surface.

The Priming Coat.—On first thought it would seem that most any kind and color of paint that is cheap is good enough for priming a new house. That is the thought that led to the use of yellow ochre thirty years ago. To-day ochre has no favor with master painters. They know its inclination to gather moisture and to let go its hold on the wood causing the paint to scale.

Experience with priming coats everywhere is diametrically opposite to first impressions. The priming is the most important of all coats because it is the founda-

tion. It is the coat where you can least afford to use any but the best materials, as it bears the same relation to the completed painting job that a building foundation bears to the structure. When the foundation lets go the best of paint scales off. Nowhere is the need for the best of paint greater than for priming.

It is quite generally agreed that all coats of paint on a job should be of the same materials, but there are some exceptions. For example on jobs which are to be painted with dark colors, green, red, brown, etc., it is better to put on a priming coat of good paint tinted gray or a light shade of the finished color. Two or three coats of some dark colors not only do not cover as well when spread over each other as when spread over a more opaque priming coat, but the cost of some dark colors, like chrome green and chrome yellow, runs the cost up on a job unnecessarily. For colonial yellow jobs it is best to make your under coats cream color or ivory, using the chrome yellow mixed with a little white for the finishing coat only.

The habit of using any old cheap paint, or odds and ends about the shop for priming coats is indeed bad.

Brushing the Paint.—Old-time painters lay much stress upon the importance of brushing the paint in and out well. This is important on the priming coat where it is well to gain as much penetration of the wood as possible to assure firm anchorage of the paint. Do not attempt to carry too much of a load of paint on the brush. Each brush has its capacity and when overloaded is sure to spatter the paint about the premises and make a mussy job, to say nothing about soiling drop cloths, ladders, equipment, cement sidewalks, window glass, etc. Take a moderate brushful, spread it on the surface roughly, lay it off or spread it out to cover a few square feet of surface and let it alone. Brush with a semi-circular stroke from right to left and back again. Dip the brush into the paint

only an inch or two and wipe out an excess load on the side of the pot.

The old-time painter, who is supposed to know all about it, says to put your priming coat of paint on thick and rub it out thin. However that may be, it is true that thin, even coats of priming penetrate the pores of the wood and anchor better and dry better. They show the grain of the wood and do not look as well as a thick coat, but on the priming coat the important point is to make a good foundation for the future coats which can be made thick enough to cover well. Thick priming coats hide the grain of the wood but dry slowly and are apt to scale off later on. A little lampblack or other dark color in priming coats for any colored finishing coats make the priming coat obscure the surface better so that it will not be so difficult to hide the dark sap streaks of the wood with the second coat. When the finishing coats are to be white a little blue is sometimes used in both the priming coat and the second coat. Then the finishing coat looks whiter because the surface of the wood is obscured better.

Putty-Up Cracks and Holes.—After the priming coat has been brushed into the holes and cracks the putty will stick to the surface. If the putty is put on to bare wood the wood absorbs the oil from the putty and the filling crumbles away or drops out.

It is important to fill all holes and cracks with putty not only to keep out wind and cold but, more important, to keep out water which, when it freezes, expands the holes, allowing more water to get in and by a gradual process allows the wood to get wet and promotes decay, swelling and warping of the wood.

In Chapter VI will be found the mixing methods for making putty.

The putty is forced into the cracks and holes with a putty knife and it should be allowed to dry before painting over it. An excess of putty is needed because some

shrinkage is to be expected. A stroke with a piece of sandpaper will cut off any roughness or bulging of putty after it is dry.

Second and Third Coats.—Mix these coats as per directions in Chapter VI and VIII. The brushing is done in a similar manner but the paint should be put on a bit thicker and more attention should be paid to making each coat cover and hide the surface as well as possible. Joints and laps must be avoided and it is especially necessary to avoid skipping some places and putting paint on thick in some places and thin in others. Try to brush the paint on with an even thickness over the whole surface. Then it not only will look better but it will wear better.

How Many Coats of Paint?—Many a job of repainting is done with only two coats and even some new surfaces are so finished, but using a minimum of paint in this manner no doubt is expensive in the end. A new wood surface needs at least three coats of paint mixed fairly thin and well brushed or sprayed on to cover well. Four coats on new wood makes a better investment because they preserve the wood better and afford a better foundation for future painting.

Old surfaces which have been well painted before may be pretty well painted as a rule with two new coats, but here again three coats are better as an investment. When too few coats of paint are put on any surface the oil soaks into the dry wood, or dry old paint, leaving the new paint on the surface without enough oil to bind the pigment together and to the surface.

Where to Begin Painting.—The high places are usually painted first. If the lower part of the building were painted first it would be marred by the ladders when reaching the upper areas and also paint from above would be splashed on the finished paint below. So the work is to be started on the cornice, up

under the roof, gables, etc. Then work your stretches of paint from left to right and back again as far as you can reach, working from the top down, and resetting the ladders no more than is necessary to comfortably reach all surface.

The trim of the building usually is painted the same color as the body for the first two coats. The finishing coat of a different color than the body is usually dark enough to cover well and hide the surface in one coat. This is not always true, it depends upon the color. Time is saved by painting the trim the same as the body for the under coats when possible.

When the finishing coat is put on the painter usually takes two pots of paint and two sets of brushes up on the scaffold with him. Then he paints both body and trim colors with each setting of the scaffold. Otherwise he would have to wait until one color dried before putting on the other.

The sash are usually painted when most convenient without making a special setting of the ladders for that, but it all depends upon how many men are available.

Rain Gutters and Down Spouts.—These and other metal surfaces should be painted after the methods described in Chapter X. Usually one man on the job is detailed to look after the odds and ends like these surfaces and the trimming of sash, porches, doors, etc.

About Painting Weather.—Condition of the surface, quality of the paint, correct application of the paint and favorable painting weather are the essentials which govern the success of painting.

Generally speaking painting may be successfully done any month in the year when the wood is dry, when the temperature is above zero and when it is reasonably comfortable to work without so much clothing on as to impede reasonable safety and speed at work. In many localities the winters are mild enough to allow painting twelve months in the year. In fact, in all

except the extreme northern localities a great deal more painting should be done during the winter months.

After the rainy seasons have passed the lumber of most buildings becomes quite as dry as during the summer months. The heating plants inside drive moisture out of the walls. So whenever the temperature is 40 degrees or above there is an opportunity to paint. Of course, paint should not be applied when the surface is subject to moisture condensation because it is snowing, sleeting or raining. Snow coming in contact with the warm sides of a building condenses and leaves moisture in the wood even though it cannot be seen. Frosts and fogs are equally unfavorable for painting. When paint is put on over wet surfaces the moisture may remain there until the warm season when the sun draws it out into blisters. The blisters break and the paint then scales off. Frosts settling on new paint kill the gloss and cause washing of the paint pigment later.

Cold, dry weather is just as good for painting as higher temperatures and certainly better than hot sunny days. It will be necessary to start painting later in the mornings and to quit an hour or so earlier in the evenings, but the short days are better than no work and the painting can be done just as well if the painter thinks about what he is doing.

New buildings should be given the priming coat as soon as the plaster is dry. Otherwise the joints and seams may open up and the cracks and nail holes will be excessively large. When the wood is pitch pine or cypress it is well to allow the wood to stand in the weather, sometimes for two or three months, then the sap or oil on the surface is taken off and it is easier to make paint stick to such lumber. But this should not be done with pitch pine during the hottest sunny season; the sun will warp the wood out of shape.

Removing Cracked and Scaling Paint.—When the

old paint on a house is cracking and scaling to an extent that indicates that all of the old paint is insecurely attached to the wood, it becomes necessary to remove all of the paint down to the bare wood so the new paint will have an opportunity to attach itself to a firm foundation, to penetrate and anchor in the pores of the wood.

How to remove old paint in this condition is the problem. Of course, the common practice is to simply scrape off the loose scales, sandpaper down the rough edges and repaint over what is left of the old material. That is all right when the old paint which remains is firmly attached, but when it is not so, the new paint is bound to scale off too, sooner or later, especially after several thicknesses of paint have been put on.

Such old paint can be and often is removed largely by the use of steel scrapers and sandpaper. Liquid paint removers can be used but are rather too costly to use on large areas. The caustic soda removers must not be used because some of the soda is likely to remain in the wood and destroy the new paint as well as the old. So the use of the paint burner is the most practical means. The gasoline paint burner torch and the acetylene gas burner torch are shown in Chapter V, Plates 90 and 91.

The procedure in doing a job of burning and scraping is to select a day when there is little wind, because it is difficult to get enough heat on the paint to blister it where there is a high wind. The burner doesn't actually burn the paint off,—it simply blisters the paint film, loosens it and a knife scraper must be used to remove the paint while it is hot.

Hold the torch and broad scraping knife as indicated in Plate 132. The torch is held in the left hand at an angle on the paint which will permit the scraper knife in the right hand to follow close back of the flame of the torch. The torch flame should be moved along

slowly as fast as the paint blisters up, taking care not to burn the wood. The painter should wear gloves at this work to avoid singeing his skin. The flame of the torch should always be pointed downward a little so the flame will not crawl up under the weather-boards at the joints and ignite the building paper under the boards. Sometimes wood shavings are found under boards and in corners of casings, cornices, etc. Keep your eye open for such danger points. The end of the

Plate 132.—Method of Using the Paint Burner Torch

paint burner generator tube should be held about two inches from the wall while at work. When not in use see that the flame of the burner is turned outward so it will not reach anything which can be burned.

Experts in the use of this tool can strip off some kinds of paint by a continuous motion. Do not dig the paint off an inch at a time. When the tool is properly used the scraper knife will slip along after the torch while the paint film is hot. Let the torch do the work, the knife should slip along steadily, if slowly.

When paint is too dry and hard to strip off easily by the torch burning method, it is customary to coat the paint with a mixture of about one fourth turpentine and three fourths linseed oil. Let the paint dry for a day or two and then begin the burning. Benzole (160 degrees solvent naphtha) is much better than the turpentine with the oil for this purpose. About half benzole and half oil are effective. Begin to burn and scrape as soon as the paint softens and works best.

Touch-Up Bare Spots.—When paint has been scraped or burned off of a wall in places here and there, but not from the entire wall, a good painter will always touch up these bare spots with a coat of paint before proceeding to apply the first coat of paint to the whole wall. It is only by building up these places that a first class job can be secured by having a uniformly thick film of paint over the whole surface.

Paint for Exterior Doors.—Something more than a plain painting job is usually wanted on outside doors of residences and many business buildings.

A coat of varnish on top of oil paint is sometimes resorted to. Then when the hot sun beats down on such doors the paint blisters or it alligators or checks. Full oil coats under varnish should be avoided everywhere. To avoid that defect proper foundation coats are necessary,—coats which contain no more oil than is necessary to bind the pigment together and to the surface.

The outside of a door on a residence may, of course, be painted any color to harmonize with the general

color scheme. Dark green, white, ivory white and black are quite commonly used.

First Coat

Considering a new door,—the surface should first be sandpapered down to remove any rough places, then clean off the dust and brush on your first coat of paint. This coat is very important and usually is mixed from white lead thinned with half turpentine and half boiled linseed oil tinted to suit with colors ground in oil. If the finished color is to be dark, this first coat may be mixed a dark gray or a shade of the final color. If the finished job is to be white or any light color make the first coat white. It should dry nearly flat.

Now fill all scratches and holes with putty mixed from white lead in oil paste, dry whiting and a few drops of any good varnish. When dry, rub over the surface lightly with No. 00 sandpaper, dust off clean and you are ready for the second coat.

Second Coat—Light Color

If the color is to be white, cream or any light tint this coat may be mixed from ¾ white lead and ¼ zinc oxide thinned with turpentine only or with flatning oil and tinted the same as the finishing color wanted. Or this second coat may be one of the prepared enamel undercoats tinted to suit with colors in japan to the final color.

Second Coat—Dark Color

If the color wanted is dark the second coat may be mixed as above from lead and zinc and tinted dark gray or near to the finished color wanted. When thoroughly dry rub this coat down lightly with No. 00 sandpaper—rub just hard enough to remove dust and dirt nibs. Keep away from the sharp edges and corners with the sandpaper—one stroke on such places may cut

through the paint to the bare wood. After sanding the surface, dust it off, being sure to remove all dirt from the corners.

Third Coat—Light Colors

One of the most convenient and satisfactory ways to finish up the job is by brushing on next one or two coats of first class factory made enamel—in white or one of the several colors now sold in this material. All enamels are not suitable for exterior exposure to the weather. There are some brands, however, which are made with linseed oil as the thinner and they give very good service for this kind of decorating.

If white enamel is at hand for this job you can tint it with tinting colors ground in japan. Mix the color with enough turpentine to make it flow freely and strain it before adding any to the enamel;—then mix the paint thoroughly.

This third and last coat may also be mixed from first class spar varnish to which about one pound of japan color or the colored paint is added per gallon of varnish.

Third Coat—Dark Colors

The second coat may be omitted if necessary to cut down the cost on dark colored jobs, not however without sacrificing some of the fine appearance of the job.

This coat should be mixed from color ground in japan and thinned with turpentine only. Apply the color with a soft, badger color brush. Many colors are available to select from and you can mix any tint or shade wanted by the addition of black or white to any japan color or by mixing varying proportions of these colors together.

When the japan color is really dry rub over it very lightly with a handful of horse hair or a dry piece of soft cheese cloth to remove dust and dirt nibs.

Fourth Coat—Dark Colors

This coat may be clear spar varnish, if good hiding ability has been shown by previous coats. If not, add a little of the japan color to the varnish—about one pound of color to the gallon of varnish. This color varnish will then prove both a protective and decorative coat.

Enamel for Exterior Surfaces.—There are on the market several high grade enamels, factory made, which give good service on exterior surfaces such as porch columns, lattice, pergolas, benches, garden furniture, etc. Such enamels are only those made with linseed oil as a principal ingredient. These enamels are white but can be tinted with colors ground in japan and thinned a little with turpentine. Strain the color mixed with the turpentine before adding it to the enamel.

A painter-mixed exterior enamel calls for the use of half white lead and half zinc oxide mixed with the best exterior spar varnish. Mix the lead and zinc together with enough turpentine to make a thick paste, add the varnish and strain the whole batch through cheese cloth after a thorough job of mixing. Such enamel will be serviceable but not as white as factory made enamels. The spar varnish has an amber color which darkens the enamel a little. It bleaches out whiter as time goes on, however.

Surfaces to be finished with enamel should be built up with at least two under coats of flat paint. On new wood the first coat should be mixed with about half boiled linseed oil and half turpentine. The second coat should dry flat, which means that at least three-fourths turpentine to one-fourth oil is needed. On some hard, well filled surfaces no oil is needed in the second coat.

One point should be kept in mind about paint coats

used under varnish or enamel coats—keep the oil in the under coats down to the least amount that will bind these coats together and anchor them to the surface. Too much oil in the under coats causes the surface to take on a checked or an alligatored appearance later. The reason for that is that the under coats full of oil are more elastic than the varnish or enamel on top. When the sun beats down on the surface the under coats expand more than the varnish or enamel coats; hence, the latter breaks up into odd shaped patches which look very much like alligator skin leather.

CHAPTER XV

PAINTING WITH THE SPRAY GUN

In previous chapters in this book the mixing of paints, the tools needed for general work and the scaffold required were described at length and in Chapter XIV the procedure, preparation of surfaces, etc., were discussed. All of this subject matter refers also to spray painting and, in fact, the best spray painter is the man who knows materials, surfaces and brush painting methods. In taking on spray painting a painter, therefore, has nothing to change, can make excellent use of his previous training and is simply required to learn the correct handling and care of the spray gun and supply units for air and materials.

Probably the first important idea to fix firmly in mind about this method of painting is that of gaining a thorough knowledge of the spray gun equipment and the handling of the gun itself. There is nothing very difficult about handling this tool, but like all other tools, best results come only from correct use. And while all spray guns are somewhat similar in a general way and some are better than others, the wise course to pursue is to take all the instruction you can get from the manufacturers of the particular equipment you are going to use. If any one knows how to get the most satisfaction out of such equipment it is the men who designed and constructed it. The manufacturers of the best spray gun equipment today are anxious to teach their painter customers what they

should know about handling spray guns. They not only supply definite printed instructions for the operation and care of the equipment, but also provide expert instructors who teach the correct use of the equipment right out on the job under actual working conditions. Such service is priced at just what it costs and it is worth much more. It is of the utmost importance to get started right in this method of paint application. The best machines are remarkably fine tools, well designed by able engineers and constructed with great skill and precision. When correctly used they will do all that is claimed for them and more.

Size and Kind of Equipment.—Most manufacturers make spray painting outfits of several sizes which are suitable for various kinds of work. For interior decorating on walls, trim, floors, furniture and fixtures, automobiles, and other articles which can be brought to the shop for finishing, a small portable and useful outfit is made. The motor is small, about one-quarter horsepower in some instances, and can be attached to any electric light socket. The large outfits have large motors which must be connected with power lines, or otherwise gasoline engines are used to run the compressors.

The small interior decorating equipments as made by some manufacturers use a siphon feed gun with the material tank holding one pint or one quart attached to the gun. Such material containers can be quickly changed for others with different materials or colors. Where small surfaces requiring small amounts of materials are to be decorated and where changes of material are frequent, this type is better than the equipment using large paint storage tanks which take longer to clean. Also the siphon feed gun is good for spraying lacquers and will atomize material into very fine spray. It will not draw up to the nozzle more material than it can atomize very fine.

Some of the small interior decorating outfits use the same spray gun types as are used for large exterior surfaces. With them a smaller paint storage tank is used, various sizes being available but separate from the gun. Some of these outfits do not have air storage tanks. They are composed of motor, compressor, paint tank and spray gun with the necessary hose. The outfit is small and light enough for one man to carry when necessary, although the outfit is mounted on wheels,—a small truck which can be freely moved about.

These small outfits spray paint, enamel, varnish, stains, sizes and are very handy for all interior surfaces which they coat more rapidly than can be done with ordinary methods.

For the painting of large surfaces with oil paints, mill whites, and other paints for decoration, preservation of surfaces, better light and sanitation, spray gun outfits with larger motors or gasoline engine power, larger compressors, air and paint storage tanks and with the capacity for supplying with air and material one, two and three spray guns working at the same time, are in common use now in many localities.

These larger outfits are especially advantageous for coating rough surfaces like brick, concrete, stucco, shingles, rough lumber and in fact any large areas of metal and wood surfaces. The work commonly finished with these larger spray painting outfits includes residence exteriors, basements and fruit cellars, barns, dairy buildings, creameries, factory exteriors and interiors of brick, cement, wood and steel, state fair ground buildings, large steel water and material storage tanks, gas holder tanks of public service companies, bridges and other structural steel buildings, large fences of wire and wood construction.

When it comes to selecting equipment it is best to take the advice of the manufacturers after stating clearly the character and amount of work you want to

do by spray painting methods. Their great experience and knowledge of technical ability and limitations of various types of outfits will aid you in making the right start.

Equipment for the painting contractor for exterior work consists usually of the air compressing unit, which includes compressor, power which is usually gasoline engine, but sometimes electric motor, air storage tank and necessary connections to make these three units work together. They are mounted on skids to be conveniently moved from job to job, or on a truck with wheels on it. The best plan is to buy these units mounted on skids and then place the whole outfit permanently in an auto truck which can be run up to the curb in front of a house to be painted or in the driveway. Enough air hose to lead from the truck to the highest point on the building to be painted is commonly used, two or three hundred feet in some cases. Then the balance of the outfit, the paint storage tank and the spray guns are handled up on the scaffold platform or roof where the painting is being done. To move such an outfit is simple indeed and several jobs can be served by the same equipment without loss of time at loading and unloading. A trailer is sometimes employed instead of a truck for mounting this outfit.

The spray gun can be worked at any height in the air. The best operation comes when the paint storage tank is kept not more than fifty feet below the gun at work, so twenty-five or fifty feet of air hose is needed from the paint tank to the gun and the same amount of material supply hose.

Management to Save Time.—Since the opportunity to speed the work and handle a large volume of painting is great, the opportunity to lose time, which means labor cost, is also great. It is important of course to so handle men, materials and equipment on any job of painting as to avoid lost time, but it is especially im-

portant to have efficient management where the work is being done by spray painting equipment, since the spray painters coat in the surface faster. Spray painting should be studied with a view to economy of movement of men, materials and equipment and the elimination of lost time as far as possible. The difference in time required to paint similar jobs by different contractors is often great enough to make the difference between profit of a very satisfactory nature and ordinary profit. That difference may be only an hour or two for the less efficiently managed job, but it may be half a day or more. So efficient, carefully planned operations are especially necessary when the greatest good is to come from painting by the use of the spray gun. The time to plan every move on the job is a day or two before the work begins. Then the right men, materials and equipment will be there at the right time and the job should progress rapidly without undue rushing of men. Orderly progress is far better than chaos for the boss, the men and the customer.

What makes for profit and satisfaction for all concerned in this kind of work is the correct use of the proper spray painting equipment, timely placing and handling of the equipment on the job, the use of enough first class scaffold equipment, forethought in planning operations, a large enough crew of men who are familiar with the work and the use of correct paint mixtures.

The paint ought to be mixed and strained ready for use in the shop. It should be tinted and the color given an O.K. before it goes on to the job.

Scaffold Equipment Needed.—While it is true that when there is an advantage in so doing about thirty per cent of the usual scaffolding used can be saved, and even fifty per cent when extension brush handles are used, there is often no economy in having too little scaffold on the job.

The best type of scaffold is that which enables the

operator of a spray gun to cover the most surface without resetting of ladders, etc. The spray gun covers the surface so rapidly that frequent moves of scaffold waste much valuable time. Scaffolds of the platform type are essential for the best results. The minimum on the average job should be three long ladders or extension ladders, four planks and six bracket hangers to support the planks.

Often it is better to scaffold two sides of a building complete so that when one side has been painted the gun operators can shift immediately to the other side. Then the scaffold from the first side can be shifted to the third side by other men and so on without loss of a moment's time.

When a contractor can so organize his business as to keep a large volume of work ahead on the waiting list, it is wise to have one crew of men for doing the moving and setting up of scaffold. Then the spray gun operators simply coat the surface and move on to the next job where the scaffold is ready. Then by relaying the first scaffold set to the third job the maximum surface is painted per day. Of course this means quite an investment in scaffold equipment, but it enables a crew of men to do two or three times as much painting and that means two or three times as much profit during the rush painting season, other things being well managed and equal.

When the scaffolding for a job is set in place all of the surface including window sash, blinds, trim, etc., should be painted. These surfaces are of course painted in the regular way with brushes and the brush painters can usually work on the same scaffold with the spray gun operators. Enough brush painters should be employed to balance up the work and have all done at the same time.

Study Surface Conditions.—What has been presented in Chapter XIV about preparation of surfaces and

special treatment for certain kinds of new wood is fully applicable when the paint is put on with a spray gun. In addition there are certain other surface conditions which must be taken into consideration. The paint on some old surfaces is found in a checked or cracked condition, even though the paint is firmly attached. Now to fill these cracks and fine crevices more paint must be put in them than is put on the balance of the surface. The bristle brush will do that but the spray gun will not. The spray gun puts on a paint film of uniform thickness over the whole surface,—just as much paint in the cracks as on the high places, but no more.

The most practical way to handle such surfaces is to spray the paint on and lay it off, smooth it out, with the bristle brush. This takes a little more time than to spray only, but it saves considerable time over doing all the application with the brush, because it saves the time consumed in dipping the brush repeatedly into the paint and transferring it to the surface.

After a first coat is sprayed and brushed on to a checked surface the second and third coats may be sprayed on in the usual manner.

A flat finished surface is required for spray painting when the best of results are to be gained. The priming coat on new wood and the second coat, too, should be mixed to dry flat, that is, enough turpentine or mineral spirits or benzole should be used in place of part of the linseed oil to make the paint film dry without gloss. Likewise the first and all undercoats on old surfaces should be mixed to dry without gloss.

When the undercoats of paint, enamel or varnish have a gloss the new coat may run, sag or wrinkle,—it may creep and crawl like water on grease. And when even slightly too much paint has been put on to a gloss surface it may run. It is possible with a spray gun to put on as much paint in one application as is put on with three or four brush coats.

Surfaces having too much gloss may be reduced to flat by wiping over with a cloth wet with benzine in the case of exterior paints. Enamels and varnished surfaces require rubbing down with sandpaper or pumice stone and water.

When ready mixed paints are used for the under-coats on exterior painting, pour off the liquid which appears on top and replace it with turpentine or mineral spirits in part or entirely, depending upon how porous the surface is and how much of the oil of the paint came to the top. Enough oil must be left in the paint to bind it.

When white lead is mixed fresh for the job the oil and turpentine can be correctly proportioned to gain a flat finish and still allow enough oil to bind the paint as required for the absorbing ability of the particular surface at hand. As a rule not more than one-fourth turpentine to three-fourths linseed oil is needed.

Some woods after being planed in the mills and subjected to the weather a while before painting develop a fuzz on the surface, and of course the rough sawn weatherboards used quite extensively now are fuzzy on the surface too. The spray painting method will not lay this fuzz down like a common brush. The spray will of course paint the surface completely, but the fuzz stands up. Where the standing fuzz is objectionable the first coat of paint on new wood should be sprayed on and then lay it off, or smooth up with a brush. That method will knock the fuzz down and the paint will hold it down. The next coat or two can be sprayed in the usual manner.

Weatherbeaten surfaces are not easy to paint by any method, because of the wide open condition of the wood pores, cracks and holes. Paint for such surfaces was discussed in Chapter VI. When paint is sprayed on to weather-beaten lumber a coat of uniform thickness is put on to the whole surface. Just as much paint

is put into the openings as upon the surface generally, but no more. A bristle brush, on the other hand will wipe more paint into the cracks, open pores and holes by repeated strokes. On such surfaces the first coat may be sprayed on and painters with brushes should follow the spray gun operator immediately to brush the paint well into the cracks and pores and to lay it off finally. Succeeding coats may be put on with the spray gun alone.

Some concrete surfaces are filled with holes like cheese. They are small, to be sure, but numerous. On such surfaces the first coat of paint may be sprayed and brushed immediately to lay off the paint and force it into the small holes to level and fill them. It isn't the roughness of the concrete which makes this brushing desirable, but the desirability of putting more paint into holes than on the high places. A spray gun will coat the roughest kind of stucco, brick and shingles perfectly without any need for brushing to lay off the paint.

Spread or Pattern of a Spray Gun.—Hunters are always interested in having a shot gun which shoots a good pattern. The pattern is the spread of the buck shot at various distances from the muzzle of the gun after each shot is fired. A good gun will show a pattern in which the shot are pretty well and evenly distributed within a circle at so many hundred feet. A poor gun distributes unevenly, many of the buck shot are on one side, top or bottom, leaving few shots on other sides.

So it is with a spray gun. When a good gun is properly adjusted, with both the air pressure on the paint tank and the air pressure at the nozzle for atomizing the paint correctly balanced, the gun will shoot a well distributed pattern, or target as it is sometimes called. The paint will cover a stretch of surface well and with a film of paint of even thickness for hours at a time.

Spray guns are constructed to shoot a flat fanlike spray and also a round, conelike spray. The flat fan spray may be horizontal or vertical. The change from one to the other is done instantly, without stopping the work of the spray, by simply turning the nozzle of the gun half way around. On some makes of spray guns the change from a flat fan spray to a round cone spray is done in the same manner, by turning the nozzle, while on others it is necessary to remove one nozzle and replace it with another to change from flat to round spray.

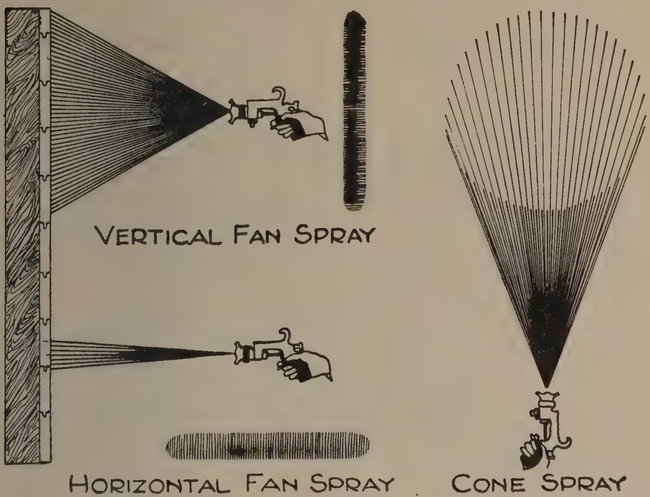

Plate 133.—Fan and Cone Sprays

The flat fan spray is best for painting large areas of flat surface, whereas the round cone spray is best for painting structural iron, pipes, poles and similar narrow surfaces. Plate 133 illustrates the flat spray when turned to the horizontal position and the same spray turned to a vertical position, also the cone spray pattern.

Some spray guns are fitted with a nozzle cap like that shown in Plate 134 in a general way, though differ-

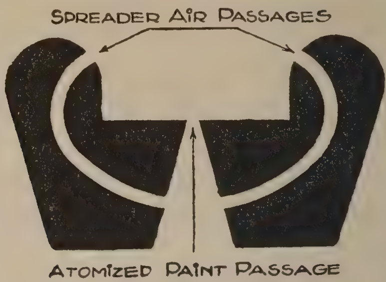

Plate 134.—The Nozzle Cap of a Spray Gun. Showing the Spreader Air Passages

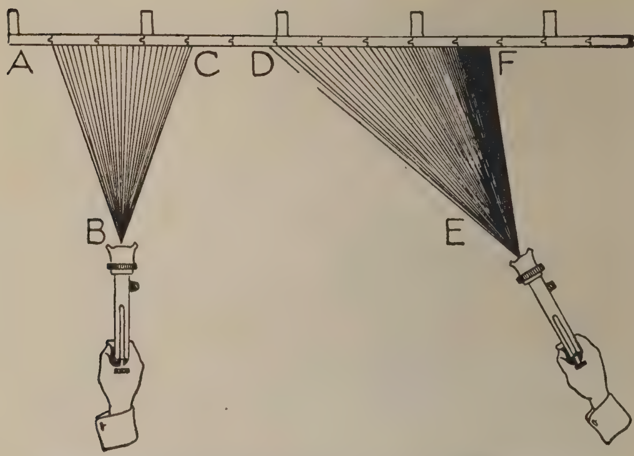

Plate 135.—Holding the Gun at the Correct angle

ent in detail with each gun. The paint and air mixture comes out of the center hole and a stream of compressed air flows out of the two passages on the sides. These air streams hit the atomized paint stream as it comes out of the center hole and spreads it into the flat, fan spray.

Holding the Gun at a Correct Angle.—The proper angle at which the spray gun must be held to assure a coating of even thickness and one which hides the surface uniformly well is pictured in Plate 135. The nozzle must be square with the surface being painted. Keep the same distance from *A* to *B* as from *B* to *C*. When the gun is held incorrectly a fat edge and a glossy surface may result at *F*. also the paint may run. The distance from *E* to *F* being less than from *E* to *D*, the paint pattern will not spread so far and will be coarser at *F*. So the paint may accumulate at *F* enough to run while the surface at *D* may not be well covered.

In Plate 136 another view of the correct and in-

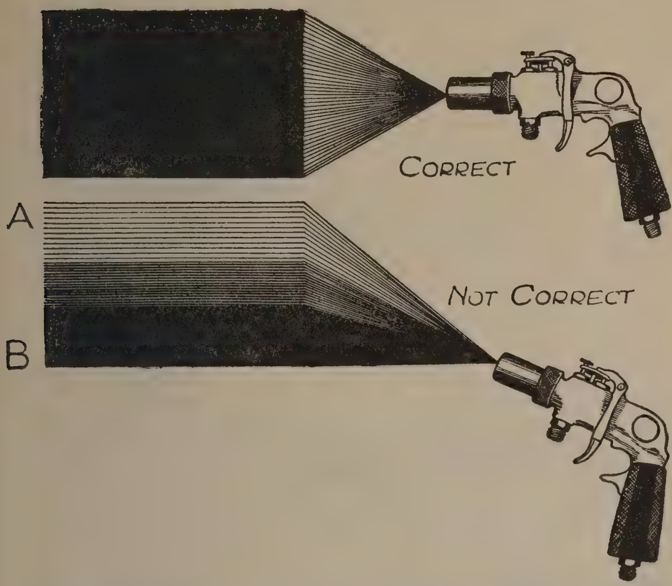

Plate 136.—Correct and Incorrect Angles for Holding the Spray Gun for Best Results

correct way of holding the gun is shown. The lower figure shows a thin, flat poorly covered area at *A* while

B shows a fat edge where the paint is glossy and may have accumulated in sufficient amount to run.

Plate 137 indicates in another way what happens when the gun is held at an improper angle for painting. The paint is laid on with a rough surface which looks like folds or ripples on the water.

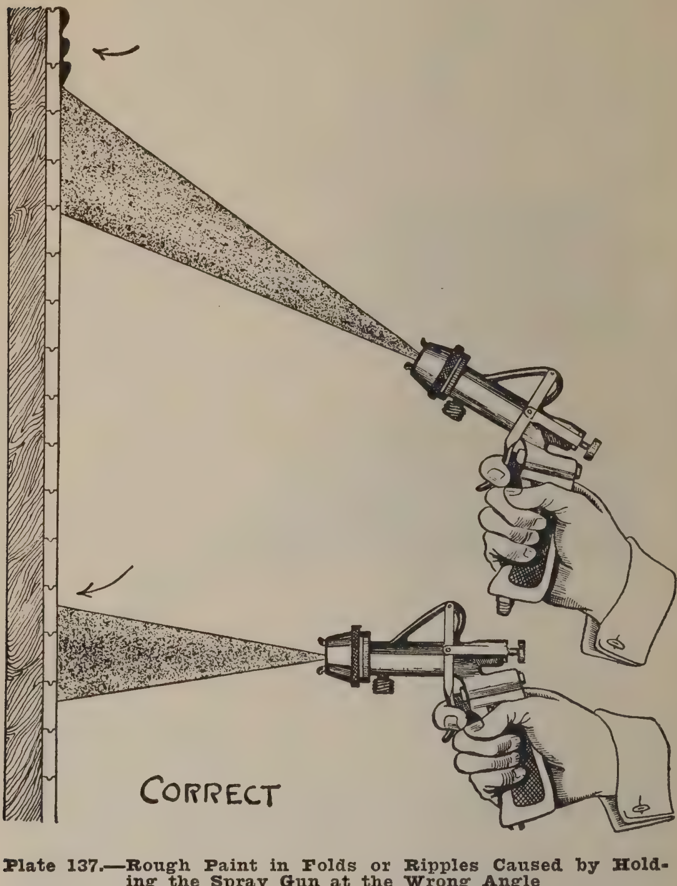

Plate 137.—Rough Paint in Folds or Ripples Caused by Holding the Spray Gun at the Wrong Angle

Distance of the Gun from the Surface.—As nearly as figures can be cited the gun, it may be said, should be held from 6 to 10 inches from the surface being painted. When the gun is held near the surface the spray is narrow and it lays on a paint film which is sharply defined at the edges. As you move the gun away from the surface the spray gets wider and the edge of the film becomes less sharp and straight.

A shield or mask is usually held in the left hand when spraying paint up close to trim, like window casings which are to be painted a different color, but an expert spray gun operator cuts a clean sharp edge without a shield to cover the trim simply by holding the gun near to the surface and moving it fast and steadily over the surface being painted. Plate 138 indicates this point. *A*, the gun held close to the sur-

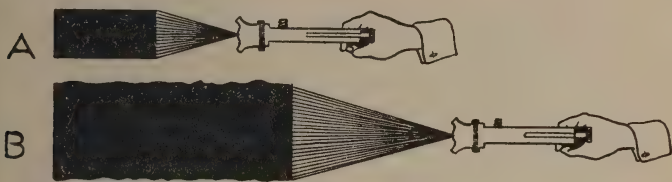

Plate 138.—The Distance of the Gun from the Surface and the Result

face,—from 4 to 6 inches. A narrow stretch painted with sharp edges. *B*, gun held two feet from surface, spraying a wide stretch with uneven edge.

Moving the Gun Over the Surface.—One of the important accomplishments which must be learned by practice is to move the gun steadily and at the correct rate of speed over a surface which is being painted. A new operator moves with a jerky motion and changes speed. The result of this action is to put on a thick and thin coating. In some places the equivalent of two or three coats of paint may be sprayed, while in others only one thin coat is put on where the hand is moved

rapidly. Perfect control of the muscular action will come with practice and also the aim to shoot the paint on the exact spot where it is needed will be perfected in a few hours of operation. The ideal is to move at the same rate of speed over the entire building surface and with the gun at the same distance from the surface.

Repeating, that is, going back to shoot more paint on thin spots or areas which have been skipped can be perfectly done by experienced operators, but a new hand is apt to put too much paint on when attempting to spray small patches. A careful operator, even though inexperienced, doesn't skip any surface.

Air Pressure Balance.—There are two points where air pressure is maintained in spray gun equipment. One pressure is on the paint storage tank, the other is at the nozzle of the gun for the purpose of atomizing the paint.

Only enough air pressure should be put on the paint storage tank to cause the paint to run slowly out of the gun nozzle, not squirt out, to begin the adjustment. This means that the paint should dribble out of the gun nozzle when the atomizing air pressure is turned off and when the gun is held as high up on the scaffold or roof as will be required to do the painting.

When too much pressure is carried on the paint storage tank more paint is delivered at the nozzle than can be properly atomized by the air pressure at the nozzle. Then the gun will spray too coarse a mixture of paint and air. Part of the paint will be coarsely atomized and part will be hurled against the surface in thick patches. The surface will be flooded in places and not covered well in others. This excess of paint will then run, sag or wrinkle, especially on surfaces having too much gloss.

The second air pressure is that at the gun nozzle. As stated its function is to atomize the paint, to break

it up into very fine particles and convey it by force to the surface being painted.

This atomizing pressure should be kept as low as possible,—it should be just great enough to atomize the paint as fast as it flows out of the nozzle. Too much atomizing pressure breaks up the paint into too fine a mist. There is more air than paint and so the mixture is too lean, too much fine mist is shot out. Over atomized paint will not hide and cover the surface well.

Too little atomizing pressure results in the same action as too much pressure on the paint storage tank.

To overcome these difficulties balance the two air pressures by the adjusting valves until the pressure on the tank feeds just enough paint to the nozzle to be completely atomized by the lowest atomizing pressure at the nozzle which can be used. The air pressures are balanced when the gun sprays on a coating of even thickness which hides the surface well.

The amount of air pressure required for both purposes is subject to variation, depending upon—

(A) The weight per gallon of the paint being sprayed. Prepared or ready mixed paints will average about 14 pounds per gallon. Sometimes a little more and sometimes less, depending upon the amount of basic pigments contained. White lead paints will weigh from 19 to 22 pounds, depending upon how much oil is used with a given amount of pigment. Red lead paint will weigh from 31 to 40 pounds per gallon, depending upon the proportion of oil and pigment.

(B) The height of the spray gun above the paint tank (not the air tank and compressor) when at work determines the amount of pressure needed on the paint storage tank to lift the paint up to the gun. Usually the paint tank is taken up on the scaffold or roof where the painting is being done. The paint tank should be kept within 50 feet of the gun at work, and 25 feet is better.

To sum up, then, a heavy paint requires more pressure on the paint storage tank and for atomizing at the nozzle than a light paint or stain. A spray gun being used fifty feet above the paint storage tank requires greater air pressure in the paint storage tank than a gun being operated ten feet above the paint supply. The pressure on the paint storage tank may vary from two or three to twenty or thirty pounds, then, depending upon the weight of the paint and the height to which it must be lifted to the gun.

The atomizing pressure varies from 10 to 60 lbs. Lead and oil paint requires from 40 to 50 lbs. atomizing pressure, depending upon how much oil or other thinner is in the paint,—lighter paints require less pressure.

About Cleaning Spray Guns.—The mark of a good mechanic in any line of business is the possession of clean, sharp and well kept tools. And while there is both pride and satisfaction in the possession of such tools which do better work, even poorly kept tools generally will do some kind of work. In the case of the spray gun, however, absolute cleanliness is necessary to make the tool work at all. It will work perfectly only when as clean and shining as a new coin. Fortunately it is easy to clean a spray gun, as the tool has been perfected with this in view. The important thing is to clean this equipment at the right time and the right time is immediately after using it.

If a spray gun is to be given a fair chance to do its work well it must be cleaned at the end of every day and upon completing every job. The gun may be allowed to stand a few hours when full of paint if it is to be used again that day. Then it should be hung up with both air and atomizing pressure turned on to reach the gun. In other words the gun should be ready to paint again simply by pulling the trigger. The paint storage tank must, of course, be kept closed.

The proper way to clean a spray gun, paint hose

and tank is to cut off the air pressure from the paint supply tank, pour out any paint left in the tank and clean out the tank. Then put benzine, mineral spirits or turpentine into the tank, connect it up again and turn on the pressure. Pull the trigger of the gun and keep open until all paint is washed out of the hose, the gun barrel and the valves, etc. Next disconnect the hose from the gun and take out the easily removable parts of the gun, wipe them clean with a cloth and immerse the gun barrel in a pot of benzine or other solvent. When all parts are clean and wiped dry the day's work is done. It is not necessary to remove the paint from the paint tank if an extra, clean tank is at hand to fill with benzine and hook up to the material hose line. The tank containing paint must be covered, however, to prevent excessive skinning over and the paint must be strained before being used again with the spray gun.

The air valve of a spray gun opens a little before the paint valve and it closes a little after the material valve. Thus the opening passages in the gun and nozzle are kept clean and free from paint by the force of the air.

The compressed air used in a spray gun outfit has a drying effect on the paint being sprayed; and so that is another reason for being fastidious and even "fussy" about keeping your spray equipment clean. Air and material passages clogged with dry paint skins alter the flow of air and materials,—furthermore the moving parts of the gun are gummed up and will not work except in a sluggish manner.

If the air spreader passages of the nozzle on the gun become clogged up with dry paint or dirt the paint pattern sprayed will be fat or uneven at the edges as noted in Plate 139. Plate 134 shows these air spreader passages.

When the nozzle passages become damaged by a fall,

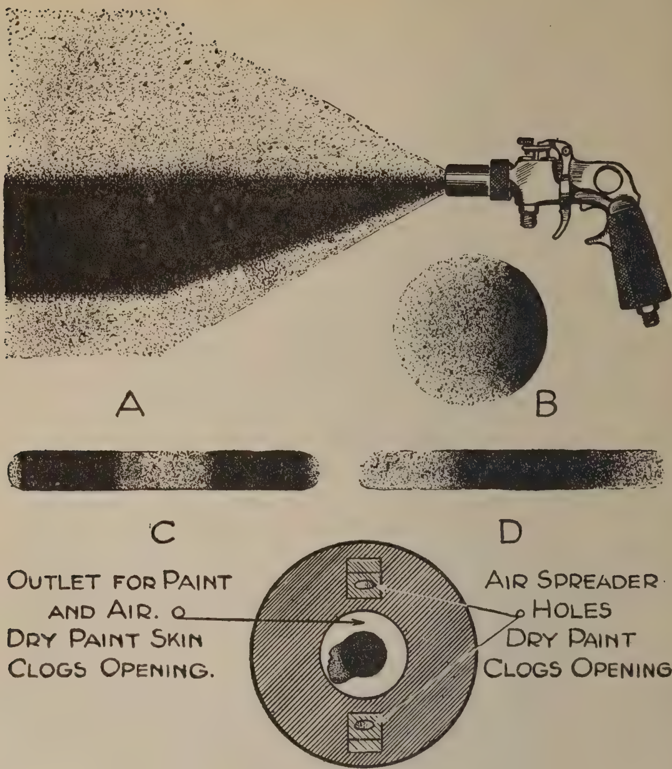

Plate 139.—Defective Painting Done by an Unclean or Damaged Spray Gun Nozzle

or from poking at them with wires or sharp tools, the spray pattern is uneven the same as when dirt or dry paint skins clog up the passages. Fat edges, fat wings or fat centers occur in the spray pattern as noted in Plate 139.

The use of the incorrect size spray nozzle with a gun may cause difficulty with the spray pattern. Take the

manufacturer's recommendation for the correct nozzle for each weight and body consistency of each kind of paint or other material to be sprayed.

Care of the Machinery.—Machines of many kinds are called automatic and they are automatic in operation, but they are not self sustaining in the sense that they do not need care. The best machine of any kind which can be bought will fail to function properly sooner or later and do itself untold damage if it is not cared for at regular intervals.

Spray machines are no exception to the rule. They are constructed with remarkable forethought to make their care easy and to require little time, but care for them you must if you want to protect your investment and get out of the machines the work they are competent to do.

Certain parts of the gun need oil and they should be oiled a little after every cleaning.

The material and air line hose should be kept spotlessly clean inside and outside. Keep oil away from them, since oil and grease rot rubber.

The paint storage tanks and control valves and connections must be cleaned every time they are used and kept free from dry paint skins and from an excess of oil.

The air compressor is usually oiled from the crankcase in which you must maintain a level of the proper kind of oil. There is a gauge, or test drain cock, in the crankcase to tell you when the proper oil level has been reached. The bearings in this compressor will wear excessively when the oil is too old or insufficient in amount. The piston and walls of the compressor cylinder will wear excessively without sufficient oil of the right kind. Then the compressor will pump oil into the air supply and will not pump air efficiently.

The automatic unloader or governor on the compressor rarely is called into use. It may become stuck

in its seat, so it is well to open it by hand once in a while to make sure that it will work if needed.

If gasoline engine is used for power, it requires that certain oil and grease cups be kept full of the proper kind of oil. The water cooled type requires attention to the water supply. Failure to care for the engine results in excessive wear of moving parts, burned out bearings, time lost trying to start the engine and expense in many ways. Follow the manufacturers' printed instructions to the letter.

If an electric motor is used for power it will require less attention. It, however, is provided with oil or grease cups to lubricate the shaft bearings. Keep them filled. Dust is detrimental to the proper working of motors. The armature and fields inside should be kept free from dust. It can be blown out often with compressed air. The carbon brushes on the motor will wear down and must be replaced at intervals. Inspect them often, not only to determine when they need to be renewed but to see that they are riding evenly on the armature surface. They should not spark when the motor is running. They will spark if any oil or dust gets on the smooth armature surface, if there are hard spots in the carbon brushes and if the armature surface becomes roughened up for any reason. A rough armature can often be smoothed up by taking a piece of very fine sandpaper about an inch wide and wrapping it over the end of a soft white pine stick of wood. When the motor is running hold the sandpaper firmly against the armature surface to grind it smooth. Repeat this two or three times. Then blow out the dust and fine sandpaper grit from the motor with air. The springs on the armature brushes sometimes break or lose their tension. All of them should bear down on the carbon with equal pressure.

Before connecting up your motor to any power or light circuit there are several points which you must

know absolutely. The large motors require too much current to operate from light circuits. They must be connected to power circuits, or circuits run into houses for cooking ranges. The smaller motors may be connected to light circuits. Also you must know whether the current is direct or alternating, the voltage, the cycle and phase of the current at hand and what is required by your motor.

Number of Coats Needed.—On some surfaces it is possible to put on with a spray gun a paint film which is as thick as that put on the usual three or four coat brush job. But it is also possible to so control and direct the spray gun as to apply a very thin coat of uniform thickness over the entire surface.

What is good practice in painting by older methods with the brush is also good practice when painting with the spray gun. Thin coats of paint dry faster and harder than thick coats. Thin coats make better foundation for future painting jobs than thick coats. So, while it is entirely practical to apply paint equivalent in thickness to three or four coats of brush applied paint, it is not wise to do so as a rule, but there are some exceptions. On many jobs it is practical to apply only one coat of paint with the spray gun and apply it thick enough to hide the surface and look well, but as a general thing two coats of paint put on with the spray gun will prove more satisfactory than one thick coat.

The limitations as to the number of coats of material required are the limitations of the paint and the surface, not any limitations of the spray gun. You can spray the material on to the surface to form as thick a film as will remain there without running and as will dry properly. A thick film is apt to dry so slowly as to pick up enough dust or insects to discolor it.

Inexperienced spray brush operators usually put on a thicker paint film than is necessary. It is easy to give a man a four coat job when he pays for only two.

That wastes material. A careless brush operator will also waste material by putting it on too thick in places.

Time and Material Required.—The first jobs finished with a spray gun by a new operator often require as much time as when the paint is put on with the brush in the common way. As experience is gained, however, speed will be acquired, too. An experienced operator working under favorable conditions will coat in from 500 to 600 square feet of surface per hour and average from 4,000 to 6,000 square feet of surface painted per day of 8 hours. There are many records of greater accomplishment in this direction, 10,000 square feet of surface in an 8-hour day is not uncommon when the job is well managed and conditions are favorable. It is obvious, however, that the management of the job as to having proper materials on hand at the right time, correct scaffolding in place and other factors govern to a large extent the amount of surface covered. And, naturally, the skill and disposition of the operator and his helpers to work are determining factors.

As to material used by a spray gun. It will vary from a little less to about ten per cent more paint than would be used for the same job and applied with a brush in the ordinary way. There is little or no loss of paint caused by working in a wind, contrary to popular ideas. The gun is held so near to the surface (8 to 10 inches) that there is no opportunity for loss in this respect. Such losses as occur are the result of spraying on paint films which are too thick or from spillage in handling the material. The latter item should not, however, be greater than when the paint is handled for brushing.

Protecting Window Glass.—It is very easy to protect window glass from paint spray or spatter. Provide a strip of drop cloth large enough for each window,—about two feet longer. Usually a 7 or 8 foot strip is long enough. Lower the upper sash, hang the

canvas over the top of the sash and close the upper sash. Raise the lower sash, tuck the bottom of the strip under it and lower the sash in place. When the windows are difficult to open, or not accessible from the inside, use glass push pins such as are used to hang pictures on interior walls to hold the cloth in place.

Brush Painting Necessary Too.—The large trim like cornice facing on the average house may be practically painted with the spray gun but small trim like window sash, doors, mouldings, etc. are more quickly painted with the brush. It is customary to have enough brush painters on a job to finish up the trim as fast as the spray guns coat the sides and large surfaces like roofs, etc.

The spray gun operator can use a mask, or guard, made of tin six or eight inches wide and a foot or two long when spraying paint close up to window frames, corner boards and other trim which is painted a different color than the body. Experienced operators do not require the mask. They reduce the trigger pull on the gun, hold the gun close to the surface to cut a sharp edge and move it over the surface rapidly. A surprisingly sharp line can be cut in this manner. A cleaner edge is often cut this way than is cut with a brush.

Health and the Spray Gun.—In the painting business, as in most other trades and some professions, it is possible to carry on business in a way which will be injurious to health. It very largely depends upon the habits of the men. Some habits are, of course, due to ignorance of the risk and the better way to do the work.

Practically speaking the health risks using the spray gun are identical with those involved in painting by any other method. The greatest risk is from inhaling dust resulting from dry sandpapering surfaces, particularly interior surfaces. Then working in rooms with turpentine, benzine, benzole, ammonia, hydro-

chloric acid, oxalic acid, fusel oil, amyl acetate, bronzing liquids and numerous other materials without having the windows open for plenty of ventilation is injurious to health and a violation of common sense.

Spray guns regulated properly to atomize the paint at lower pressures and used from 6 to 10 inches from the surface as they should be used, have little opportunity to cast off an amount of spray which is injurious when the ventilation is what it should be. When working in rooms which are small, bathrooms, closets, etc., it is advisable to wear a mask or respirator.

It all comes down to the fact that a careless, sloppy painter can injure himself with the spray gun just as he can with a swing stage, extension ladder, blow torch and sharp tools of many kinds. Reasonable care and clean habits will assure a safe and efficient use of spray guns and other painters' tools.

Durability of Sprayed Paint.—There are innumerable jobs upon which the paint was sprayed a dozen years ago about the country and enough time has passed to confirm the statement that the durability of paint which is sprayed on is exactly the same as the durability of that paint if it were applied by other means. The spray gun doesn't alter the paint except that sometimes more volatile thinners like benzine, mineral spirits or turpentine are added to reduce the body of the paint. These thinners, however, evaporate completely and almost immediately leaving the paint as it was before spraying.

The spray gun drives the paint into every crack and hole, giving the paint ample penetration and anchorage in the pores of the wood. There has been much talk among old-time painters about forcing paint into the wood by rubbing it in well with a brush, and while there is no doubt that good brushing is beneficial a study of a wood surface painted by any means, brush, spray or dip will show that after all the paint remains

on the surface and gains very little penetration. Cut a painted board in two making a clean cut with a knife. Study it with a magnifying glass and you will get this point better.

A confirmation of this idea comes from the methods which were found necessary among the railroads in the treatment of wood ties. They are dipped in a creosote oil preservative to keep them from rotting. Penetration to any considerable extent by this very thin liquid was not gained until the ties were treated with the dipping process carried on in a tank from which the air was largely pumped out to create something like a vacuum. Even then penetration of the preserving liquid is not more than a fraction of an inch after the ties are dipped and soaked in the liquid.

The difficulty encountered when we try to make paint penetrate deeply into wood is, simply, that of working against air pressure in the wood. The structure of a living tree is somewhat similar to that of a sponge. The cells of the wood are filled with sap or water. When the wood is seasoned by air, or in a kiln, the liquid is driven out. Nature will not allow a vacuum and so air rushes into the open pores. Now to fill those pores with paint we would have to draw out the air. Paint simply seals up these pores or air cells and penetrates only in a limited way whether brushed, sprayed or dipped.

Drying Time Required.—Because paint sprayed on covers a surface so quickly, there is a tendency to rush the work, largely through anxiety to finish the job and move on to the next one when an organization is keyed up to volume production. Fully as much time should be allowed for the drying of the paint between coats as when the paint is put on by brush methods. Then the undercoats will become harder and a more durable job is bound to result.

Creeping and Crawling.—When the undercoats of

paint are not fully dry, when a wood surface is oily, like cypress, when undercoats of paint have too much gloss, paint which is sprayed on is likely to creep and crawl,—that is, the new coat acts like water on oil, it will not stay where you put it. Brush coats of paint do the same thing, but sometimes a brush coat can be made to stick to a surface by repeated brushing when a sprayed coat would not stick.

If a paint surface, or a bare wood surface like pitch pine or cypress, is wet from dew or frost or fog the paint may creep and crawl. Water or oil in the paint from the air supply would cause this same trouble. When the air is very moist the condenser may liquify a little of it. If this water gets into the air tank and accumulates until it is forced out into the air hose and through the spray gun, it may cause a little temporary creeping and crawling of paint.

The remedy for this difficulty is to have your under coats dry and flat and clean. A coat of dry paint with too much gloss can often be remedied quickly by wiping over it with a cloth wet with benzine or turpentine. Or, sometimes a bit of benzine sprayed on to the paint is sufficient to overcome the trouble. When sprayed paint creeps and crawls it is often quickly made to stay where you put it by simply brushing over the paint with a brush. Varnished and enameled surfaces sometimes must be rubbed down with sandpaper before they can be painted with either spray or brush. A thin coat of benzole (160 degree solvent naphtha) brushed on will cut the gloss and rough up the varnish enough to allow paint to adhere to it.

Paint Runs.—What causes paint to creep and crawl sometimes causes it to run, sag and wrinkle. The remedy then is the same, too. When a spray gun is held too long in one place with the trigger pulled open, more paint is sprayed on to the surface than it will hold. And of course moving the gun too slowly over

the surface amounts to the same thing. It must be moved steadily and fast enough to put just the right amount of paint on the surface to hide it well and stay there. With a little practice and observation this is easily done. When the air pressures on the paint in the storage tank and at the nozzle are not balanced, too much paint will be put on in spots or streaks and then it will run. When the paint is too rich in oil, having been mixed with too little turpentine, mineral spirits or benzine, it may run if sprayed on to a hard, non-absorbent surface or a very cold surface.

Crimpy, Puckered Paint.—When the paint is put on too thick it gets crimpy, or wavy, and will dry in that condition if not brushed out well and evenly. The remedy is to readjust the gun and add more turpentine or mineral spirits to the paint to make it thinner.

Paint Doesn't Hide Surface.—Paint which has been mixed too thin and paint which is of poor quality fail to hide the surface well, even when well spread out to an even thickness. Cheap paints lack opacity and no quantity which could be sprayed or brushed on will hide the surface as well as good paint.

CHAPTER XVI

EXTERIOR STAINS AND STAINING

The procedure in doing a staining job is even more simple than on painting work. When both roofs and shingle belts or gables are to be stained where part of the building is also to be painted, it is advisable to complete the staining operations before the painting is done. Stain is so thin that it spatters and splashes without a show of much carelessness, and if stain of the creosote type is splashed on to newly painted wood, it will be difficult to remedy the defect at once. So finish staining the roof, gables, frieze belts and brick chimneys before going on to the painting.

Stain may be applied with flat wall brushes or with spray guns. Stains on roof shingles especially are much better preservatives when the new shingles are first dipped into stain and then brush coated after being nailed in place on the roof.

Stains for Exterior Surfaces.—The use of stains on wood shingles placed on roofs and sides of houses is growing in favor. Stains on other exterior wood, such as rough-sawed clapboards, porch timbers and even on walls and chimneys built of common yellow brick are in common use. Unlike paint coats, shingle stain doesn't hide the wood grain. It colors and brings out the wood grain figure; it preserves from decay.

In some sections there are wood boring insects, white ants and others, which attack shingles unless protected with a creosote stain. And shingle stain also protects against fungus growths which occur in some climates. Such growths promote decay by harboring moisture.

Dipping Shingles.—The best handling of shingle stains is to dip one coat and brush one coat. Dipping gives a more uniform color. The shingles are dipped two-thirds their length. A barrel or tub is used. A metal trough is placed with one end on the tub or barrel and the other end raised so the excess stain will drain back into the barrel. Note this equipment in Plate 140.

The dipping operation is done by first breaking open

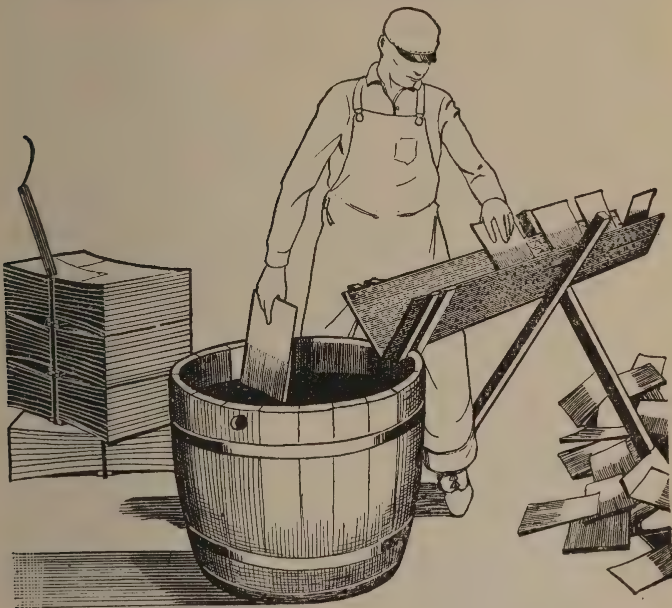

Plate 140.—Dipping Shingles in Stain

a bundle of shingles; then take as many shingles as you can hold in two hands and with butt (thick) ends down dip them into the stain. Pull out the shingles immediately and place on the drain trough and dip another batch. When the drain trough is full remove

the first few lots of shingles dipped and scatter them in a pile loosely on the ground so they will dry. Allow the shingles to dry at least over night before gathering them again into bundles or handling. The shingles should not be allowed to soak in the stain—dip them in and pull them right out again.

Mottled Colored Roofs.—Color blend roofs are artistic, indeed, and are becoming popular. They are produced by dipping the shingles for one roof into from two to four different colors or shades of one color; —that is, a few handfuls of shingles will be dipped into light gray, for instance; then some are dipped into a little darker gray and next a still darker gray is used. All the shingles are thrown into one pile loose to become mixed. They are laid just as they come, giving the roof a varigated or mottled appearance. Sometimes various colors are used such as dull brown, dark brown, dull gray, dull green, dull red-brown, etc. The stain liquids have very little color in them and so the difference in the colors of various shingle batches are very little, but on the roof a beautiful mottled blend is the result. If strong greens, reds, browns, etc., are used the artistic effect is lost, in fact, the roof would appear quite as much in poor taste as the many mixed color composition shingle roofs one sees.

Staining Old Shingles.—Restaining old roofs which have been stained before is often done, and, of course, only one or two brush coats are possible. Best results come often from staining the same color as before, but some changes of color are effective. A restained roof over old stain will dry out darker than the same stain on new shingles. An old red stained roof cannot be stained green satisfactorily. Your green stain is transparent and will not hide the red color,—and the reverse is also true.

A light brown old stain can be restained with red stain and the result will be a deep maroon. Dark

brown over light brown succeeds well, while dark green over light brown makes an attractive dark green.

Paint vs. Stain.—Shingle roofs in some sections are painted with common house paints mixed rather thin, —with about one quart extra of turpentine per gallon of paint.

The painting of old shingle roofs is of doubtful merit, in fact, there are good painters who reason that to paint shingle roofs hastens their destruction by decay. Their theory is that even when carefully painted the paint seals up the top surface only of each shingle. The sides and butts to some extent remain open and absorb the rain and snow. The paint on top of the shingles, then, not only fails to keep water out but prevents the shingles from drying out, or at least retards the evaporation of the water and favors decay. Stain doesn't necessarily seal up the wood, but creosote and linseed oil have preservative qualities.

If new shingles were dipped in paint and then brush coated, they would, of course, be well preserved. This is not a customary method as far as the author is aware.

Suitable Stains.—Certain manufacturers have done extensive research work in this field and have developed remarkably beautiful stains which are both brilliant as to color and permanent. Strictly speaking they are not non-fading in sunlight but they fade only enough to subdue and soften the vivid colors and that adds beauty to them. Even the vivid blue-greens retain their lively hue after many months in the sun, although a bit subdued and softened in tone. Some stains are good protection for the wood, especially when the wood is dipped first and then brush-coated.

When any considerable area of surface is to be stained it is most practical and satisfactory to purchase factory-prepared shingle stains, especially in the vivid greens or other bright colors. Such stains are always uniform in color and composition.

Stain Formulas.—Shingle stains have been mixed by painters in past years using the best grade of tinting colors, ground in oil, such as are used for tinting white paint:—

Brown Stain.—Use burnt umber, or raw umber. Black asphaltum varnish thinned with turpentine or benzine makes a good brown or weathered, mission stain.

Yellow Stain.—Raw sienna makes the most durable light brown or yellow stain.

Green Stain.—Medium or dark chrome green is the only color available to the painter. Such a stain fades rather too quickly in sunlight to be satisfactory. A stain mixed from raw umber, raw sienna and enough chrome green to make a dark green is more durable. The factory-prepared green stains are much more permanent as to color, as a rule.

Red Stains.—Burnt sienna and Venetian red are the most satisfactory for red stains. They are earth pigments and are permanent as to color in the sunlight.

Black Stains.—Raw umber and ultramarine blue make the best blue-black stains. Lampblack may be used. Asphaltum varnish and benzine or turpentine brushed on generously make a dark brown stain that is nearly black.

Blue Stains.—Ultramarine blue is the most practical, more so than Prussian blue which fades rapidly when exposed to sunlight. Factory-made blue-green stains are better.

Silver Gray Stain.—Gray stains are much in favor for both exterior and interior surfaces. Such a stain may be mixed on this basis:—

20 lbs. zinc oxide in oil paste
1 qt. pale japan drier
1 qt. raw linseed oil
½ gal. yellow cresylic acid
1 or 2 ounces lamp black
1 to 2 gal. benzine

Cresylic acid is used as a preservative instead of creosote oil which would discolor a light gray stain.

Liquids for Stains.—The liquids used with tinting colors are these: Thin the tinting color paste with turpentine to rather thick brushing consistency. Then thin finally with these proportions—2 gallons raw linseed oil, 1 gallon coal tar creosote oil and ½ gallon of japan drier.

The crude creosote oil (dead oil) is very dark in color and smells like carbolic acid. Not a pleasant material to work with; in fact, it will burn the skin. When dipping shingles one should rub linseed oil over the hands and face, also wear gloves as a precaution. If the oil does get on your skin, rub oil, not water, on it and wipe off with a cloth. Water makes it burn more because crude creosote oil contains water-soluble acids.

Crude creosote will dry on any surface, even on metal, unless thinned with kerosene. Benzine is better for thinning to make the oil lighter in color so tinting colors added to it will exert their strength. Refined creosote is better for making colored stains, although the crude oil is suitable for very dark colors.

For dipping shingles or clapboards thin one gallon of the color paste (which has been previously broken up with turpentine) with about 7 gallons of the liquids —linseed oil, creosote and japan drier in the proportions described above.

For brush coats mix about 2 gallons of the color and turpentine mixture with 7 gallons of the liquids in the above proportion.

When cheaper stains are to be mixed the liquid portion may be mixed in these proportions and with these ingredients:—1 gallon kerosene (water white 150 degree test) 1 gallon coal tar creosote oil and 3 pints of japan drier.

For covering capacity of stains see chapter XIII.

CHAPTER XVII

PAINTING DEFECTS, CAUSES AND REMEDIES

When thinking about paint and painting there appear to be no constants,—all elements are variables. It is quite impossible to find a job of painting which is exactly duplicated by another as to surface, paint, workmanship and weather. There is continual necessity for exercising good judgment. And so, obviously, considerable knowledge of surface, paint, proper application and suitable painting weather is essential.

When a job of painting fails it is not always easy to find the cause. We ought not to draw hasty conclusions because a proper conclusion must be based upon knowledge of all factors. These four elements influence the success or failure of every paint job:—

1. *Surface*—Kind, whether soft and porous, hard and impervious in structure, open or close grain, tough or weak fibre.

Condition,—dry and well seasoned, air seasoned or kiln dried, wet, full of oil, sap, gum and resin, rough or smooth.

2. *Paint*—Very soft and chalky, moderately soft and elastic, very hard and brittle, moderately hard and elastic, very elastic and tacky.

3. *Workmanship*—Correct brushing, sufficient brushing, application of a coat of even thickness and uniformity, time allowed for drying between coats, mixing proportions of pigments, vehicles and thinners.

4. *Weather*—Rain, snow, sleet, frost, dew and temperature at time of application of the paint.

We soon forget conditions of surface, weather, and as a rule have no measure or record of the workmanship on a job. So usually the failure of paint satisfactorily to protect or decorate a surface is stated as having been caused by poor paint or a poor painter. And it is easier to lay the blame on the material which is tangible and ever present when all other elements have been forgotten.

Paint value is relative. No paint is foolproof. The best of paint when subjected to unfavorable conditions of surface, workmanship or weather is apt to fail. That is why we must have not only good paint but good painters who have the necessary experience and knowledge upon which to base good judgment and so assure proper application of good paint to fit surfaces and under favorable conditions.

Cracking and Scaling Paint.—Perhaps the best thought to fix in mind first about this form of paint failure is that all surfaces painted, wood, brick, cement and metals, expand when heated by the sun and contract during cold weather. In fact surfaces alternately expand and contract each day and night as the sun heats them up and the night cools them off. In other words, there is constant movement of the surface painted.

If there was no movement of surface or if paint expanded and contracted to the same degree as the surface under the influence of temperatures it would be less difficult for paint to remain attached to the surface. But paint expands to different degrees or amounts depending upon how much or how little oil is used with the pigments.

It is plain that when a surface expands more than the paint covering it the paint film cracks. Likewise when one coat of paint, an under coat, expands more than a top coat the top coat cracks. The weather gets into these cracks and usually the paint scales off.

With certain kinds of paints the oil of one coat penetrates other coats and tends to establish an equilibrium. But, of course, when a coat lacking in oil and elasticity is spread over a coat rich in oil, but which is dry, there is no such balancing of the oil content.

Another factor which is concerned in the cracking and scaling of paint is that of penetration. When paint is so mixed that it gains good penetration into the pores of the wood and anchors itself, there is much less likelihood that the paint will scale off. Paint which has cracked usually scales off eventually, but not always.

Cracking of paint is usually considered that condition when the cracks on being looked at with a magnifying glass extend clear through the paint coats from top to the bare surface. Checking and alligatoring, on the other hand, refer to the condition where the cracks are only on the surface coats of paint. The cracks are usually fine and are superficial.

In the condition called cracking the cracks are usually wider apart, including wider areas between and they may run either parallel or across the grain of the wood.

Wood shrinks a great deal more across the grain than in the direction of the grain on drying or seasoning. How much lumber shrinks after being painted depends, of course, upon how well seasoned it was before painting. Considerable shrinkage is possible as may be noted from the wood fibre construction. A piece of wood is not a solid, but is made up of fibres and cells. The cells are filled with water. Proper seasoning removes most of this water by air or kiln drying methods.

When wood shrinks excessively after painting the paint is bound to crack and to bulge. The cracks will extend in the direction of the grain length, although the shrinkage is across the grain. The wood fibres run parallel to the grain of the wood, so when the moisture leaves the fibres come closer together, causing the shrinkage across the grain of the wood.

Upon drying, paint shrinks to some extent. Linseed oil shrinks in volume, although it gains in weight upon drying. How much the paint shrinks upon drying depends upon whether or not there is a chemical reaction taking place in the paint after application. The shrinkage of the paint is in all directions, while the wood shrinks considerably across the grain but hardly to any appreciable extent parallel to the grain. When the wood contracts more across the grain than the paint, the paint bulges and then cracks in the opposite direction.

It is obvious, then, from these facts that good paint must be elastic enough to expand and contract with the wood in order to avoid cracking and the scaling which follows as a rule.

The remedy for the prevention of cracking and scaling consists of controlling both the composition and the mixing proportions of paint pigments and liquids. Thick paint films are more likely to crack and scale than thin ones. Paint may not scale for years,—until the surface has been painted about three times. If the paint used each time doesn't gradually wear off, that is, chalk off moderately and naturally, it will sooner or later form a thick film which is too hard, brittle and inelastic. Because the film is so thick it is strong and heavy. The moisture in the wood, then, more easily forces it off in scales.

The paint, then, should be mixed so it will wear off very slowly. A balance must be found. If the undercoats are too soft as a result of the oil content and the pigment character the softness will promote checking. If the undercoats are too hard and inelastic they will promote cracking and scaling.

Having the wood well seasoned and thoroughly dry at the time of painting is also one of the best ways to overcome scaling and cracking.

Very soft woods like cottonwood when painted with moisture in the wood will dry-rot under the paint. The

wood fibres so weakened crumble and of course the paint cracks and scales off. Also this wood moulds very quickly when wet and paint put on over mould is apt to crack and scale off when the weak fibres crumble because of the mould.

A study of this subject will lead one to note that poor paint often doesn't manifest its weakness until a house has been painted about three times. At the end of ten or twelve years the paint film has become so heavy and thick that it falls off of its own weight, after cracking and scaling has developed a little. So, unfortunately, we must often go to the point where repainting has taken place twice to determine the value of paint. The first painting may be satisfactory, and sometimes even with paint which is too hard and brittle to wear off gradually the second painting will stand up without a great deal of checking, cracking or scaling, but the third painting tells the tale and brings on the expense of burning and scraping all of the old paint off before a substantial job can be done which the painter can afford to guarantee against continued cracking and scaling, no matter how good his new paint and workmanship may be.

Blistering and Peeling.—Many do not differentiate between cracking and scaling and blistering and peeling, yet there are important differences. Moisture plays a part in both cases, but in the case of blisters the moisture gathers in spots under a film which is not cracked, under paint which is firmly attached to the wood.

When wood is painted while wet from lack of sufficient seasoning, when painting is done while it is raining, while there is frost, dew, mist or snow on the wood the moisture is sealed up. Moisture has the faculty of gathering together in one place and then the hot sun on the surface draws it out of the wood and into a pocket between the paint film and the wood. Next

the paint film breaks from pressure set up by the heat of the sun and the paint over the blister naturally peels off. The peeling is not general over the whole surface, but only appears in spots where moisture or sap accumulates.

Wood may become wet in many ways. It may be too young, too little time having been allowed for the green wood to dry out. Wood may become water soaked from careless use of water by the plasterers in new buildings, from leaks in roofs, rain gutters, flashing over windows and doors or from leaks in plumbing or heating pipes. Moisture may creep up into wood in contact with the earth.

Oil or grease on a surface painted over will also cause blistering.

The use of old fatty or rancid linseed oil will cause blistering of paint.

Whatever the explanation as to the cause of the moisture, the remedy for the difficulty is to remove the cause first. When the supply of moisture has been shut off, let the wood dry out thoroughly, scrape off the blisters, touch up the bare spots of wood and repaint the whole surface.

When the painter is at all suspicious that the wood is not dry in a new building he is wise to allow much more time than usual for drying after the priming coat has been put on. This thin coat will allow moisture to escape through it from the wood out much more effectively than it will allow more moisture to get into the wood from the outside. As a rule there is much more dry weather than wet. A month for drying after the priming coat is none too much in some cases.

There is no necessity for burning and scraping all the paint off of the whole surface of a building when there are only evidences of blistering and peeling. That is purely a local condition. But when it is a case of cracking and scaling, indicating an insecure

anchorage of the paint on the whole surface, there is no remedy which will justify giving a guarantee against future cracking and scaling unless every inch of the old paint is removed down to the bare wood, so the new paint can gain anchorage and penetration for itself. It cannot depend upon the old paint which is an insecure foundation.

The paint on iron and steel surfaces will blister and peel off sometimes. And it is impossible, of course, that this is due to moisture from the surface. These metal surfaces will, however, rust under the paint when conditions are favorable for electrolysis. The blisters may be formed by some gases released from the corroding, rusting action of the electric currents on the metal.

The blistering of paint noted on doors which face south is usually due to painting the doors with coats mixed too rich in oil; the paint is too elastic. Sometimes such doors contain moisture from poorly seasoned wood. The remedy in such cases is to burn and scrape off all of the old paint and varnish. Then mix your first coat of paint with about one fourth linseed oil and three fourths turpentine. The next coat or two should be mixed to dry entirely flat. Colors ground in japan and thinned with turpentine only are often used for the second and third coats. The last coat, then, is first class spar varnish. The method used by English decorators in such cases is to put on two coats of water paint and one or two coats of oil paint on top. If the final coat is to be varnish, the next to the last coat must be mixed to dry flat, with turpentine mostly and very little oil.

Blistering usually occurs only on new coats of paint on new surfaces, but when both moisture and heat are excessive it may occur on old paint too. The moisture which came out and caused the blisters may disappear, but the paint remains detached from the wood and will peel off sooner or later.

Checking and Alligatoring of Paint.—This is the condition of paint which shows many fine surface checks or cracks which do not go through all coats to the bare surface below. Note this difference. Cracking as explained heretofore shows deep cracks to the wood.

When paint shows numerous fine cracks enclosing areas of small size it is called checking, while larger areas of paint in the same condition are called alligatoring. In the latter case one or two sides of the paint of each area may be curled or turned up while the others are apparently attached firmly to the surface. These two conditions are no doubt the result of the same causes. Alligatoring is said by some authorities to be a continuation of checking. It is so named because the paint in that condition looks like the skin on the back of alligators. At any rate when the cracks are fine interlacing lines the condition is called checking and when the cracks are larger, farther apart and enclosing larger areas of paint within them the condition is called alligatoring.

The use of heavy coats of slow drying paint on wet or unseasoned wood, or wood loaded with sap, gum or resin may cause alligatoring or checking. Tough and inelastic paint is especially a favorable factor in developing this defect. The application of varnish over undercoats of paint which are rich in oil and consequently more elastic than the varnish will cause alligatoring of paint. This is easily noted on much of the graining work done on window sash. If the undercoats are yellow ochre or any similar paint which doesn't dry hard the alligatoring is especially pronounced.

The application of a second coat of paint over a first coat rich in oil before the first coat has time to become thoroughly dry, not just dry enough on the surface to permit brushing on another coat, affords a favorable condition for checking or alligatoring. The first coat

remains soft while the second coat continues to oxidize until much harder than the first coat.

When we have undercoats which are more elastic because they contain more oil or because they have not been allowed to dry thoroughly before the next coat has been put on we find that the last coat continuing to dry gets harder, less elastic and shrinks more than the under coats. Then the last coat cracks up into the condition we call checking or alligatoring. The way to avoid this defect is to allow your undercoats to become thoroughly dry, not merely dry enough on the surface to permit spreading on another coat, and to have fully as much or more oil in the last coat as in the undercoat. Usually less oil in the undercoat is to be preferred. Too much oil in undercoats causes creeping, crawling, running and sagging during damp or cold weather.

When undercoats of paint have non-drying mineral or other non-volatile oils in them, when the undercoats are yellow ochre or any paint which will not dry hard checking or alligatoring is quite certain to appear as the finishing coat becomes dry, shrinks and gets harder with oxidation.

The causes and remedy for checking and alligatoring were ably expressed by Dr. G. W. Thompson, Chief Chemist of the National Lead Company in these words: "From the writers' experience, the causes of checking are identical with the causes of alligatoring, and he has experimentally produced a series of paint defects beginning with very fine checks on one side and ending up with very large alligatoring on the other side. If alligatoring takes place, it simply means that the under coat is relatively much softer than the outer coat. If checks occur, it means that this difference in the hardness of coats is not so great as in the case of alligatoring, but the difference is in degree, not in kind.

"In order to avoid checking and alligatoring, it is best to seek to have the undercoats as hard as is practi-

cable, and to have these coats, relatively speaking, much harder than the outer coats. This is the practice in coach and carriage painting, where very little oil is used in the undercoats, and as we know coach and carriage painting is perhaps the best type of painting there is. Now in the case of house painting, suppose we have checking and want to avoid it, how shall we proceed? The answer is inevitable. We must so modify our undercoats as to secure a hardness sufficiently greater than that to which the outer coat will attain, and then checking will be avoided. To make the undercoats sufficiently hard, various methods can be adopted.''

There is reason to believe that checking and alligatoring, being only surface conditions and not going through all paint coats to the bare wood, are to be preferred to cracking and scaling as the lesser of two evils. A checked surface may be painted over without burning and scraping off all of the paint, while cracked and scaled paint must be removed because the cracks go through all coats and because the paint has lost its attachment to the wood. If you make paint too hard in attempting to avoid checking it will crack and scale off. If you mix all coats too soft to avoid checking and also cracking and scaling you are apt to produce chalking. But chalking moderately is a desirable occurrence, it is the better choice between two evils one of which is necessary.

As in the case of blistering and peeling the best precaution to avoid checking and alligatoring is to allow plenty of time between coats of paint to assure complete and hard drying of the under coats before the final coats are put on. Avoid the use of non-drying oils like kerosene and other mineral oils, avoid the use of slow drying materials like ochre and lamp black in large quantities and avoid the use of materials which do not dry hard like asphaltum paints and varnishes under finishing coats on exterior surfaces. Avoid the use of

old fatty or rancid linseed oil which has stood around in open pots for some time. Avoid the use of rosin oil or similar rosin products, hard oil, etc.

Chalking of Paint.—At the outset it should be kept in mind that moderate chalking is as stated before the better choice between two evils one of which is necessary. Excessive chalking is not desirable or necessary.

All paint will wear out sometime and it usually wears out in one of two ways, speaking generally. Paint will either crack and scale off, necessitating removal with blow torch or gas paint burner and scrapers, or it will chalk off leaving a surface in good condition for repainting.

What constitutes moderate chalking and excessive chalking is the point of interest. A paint which is too soft, one which lacks enough linseed oil to satisfy the suction of the wood or old paint and to leave enough oil on the surface to bind the pigment together and to the surface will chalk excessively. But such a paint will remain elastic enough to avoid cracking and scaling, even though it does lose its gloss too soon and does dust off the surface too rapidly, making repainting necessary before reasonable service has been given. A paint which is mixed from pigments which form too hard a paint film will never chalk but it will crack and scale off. The perfect paint is that which is hard enough to retard chalking to the utmost and yet avoid cracking and scaling, one which wears out finally by slow chalking and leaves the surface in perfect condition for repainting and avoids the expense of burning and scraping off old paint.

White lead, lithopone and titanium oxide paints are said to be too soft when used alone and to chalk, while zinc oxide is said to be too hard and to promote cracking and scaling if used alone or in excessive amounts with the first named pigments.

Whether chalking is desirable or undesirable, then,

is a matter of degree. Excessive chalking means that the dry pigment will brush off on the clothing, it will powder off and will be washed off by the rains. Moderate chalking is hardly perceptible, the action is so slow. The best of paints do not remain in good condition on an average more than three or four years. If by the end of that service it has chalked enough to reduce the thickness of the film a little and has left the surface slightly rough with a "tooth" which helps the new coats of paint to gain firm attachment, that paint has served well. It avoids the accumulation of a thick body of paint which favors cracking and scaling later on when the film becomes very heavy, too heavy to be held to the surface by the penetration and anchorage of the priming coat which is a dozen or more years old during the movements of the surface caused by temperature changes.

How to slow up the rate of chalking of paint and to reduce the extent to which chalking may proceed, without making a paint which is so hard and inelastic that it will crack and scale off, is the paint problem which has received a great deal of attention for many years. In the manufacture of prepared or ready mixed paints paint chemists have added zinc and inert pigments to white lead on the theory that a mixture of these two pigments, a hard one and a soft one each, would add its virtues to the paint. In the very recent development of titanium oxide paints, zinc is added to the former to offset its marked tendency to chalk excessively. And to lithopone in its improved form zinc and inert pigments like barytes and silica are added to make paint for exterior surfaces.

Chalking is kept down to a moderate degree in the use of white lead paints by judicious use of linseed oil and turpentine. Only enough oil is used in the priming coat on new wood to satisfy the suction of the wood and bind the pigment together. A few years ago lead was

mixed for the priming coat with from 5 to 6 gallons of oil and 1 gallon of turpentine to 100 lbs of white lead. Now the best thought is that about 4 gallons of oil and 1 gallon of turpentine is the best proportion for the average new wood. And for the second or body coat much less liquids are used in order to put more pigment on the surface and make a harder wearing more compact film of paint. The proportion of liquids for the second coat are commonly stated as 1½ gallons of oil and 1½ gallons of turpentine to 100 pounds of white lead. The turpentine has about twice the thinning ability of oil, so the paint really isn't as thick as might appear on first thought. The finishing coat for this method uses from 3½ to 4½ gallons of oil and only 1 pint of turpentine to 100 lbs of lead. Painted in this manner the chalking of the paint is reduced very considerably.

The natural wearing out or chalking of paint is accomplished both by mechanical action of the weather, atmospheric oxygen, and chemical actions going on in the paint. The destruction is progressive. When the surface or outer layer of paint chalks or washes off another layer is exposed to this action and so continual action is taking place until the final and complete destruction of the paint, leaving the wood bare and exposed to destruction. So the best paint chemists of today mix their paints to establish a chemical balance between pigments, oil vehicles, volatile thinners, driers and colors aiming to produce an ideal paint which will not check, crack, scale or flake off, but will chalk or wear away very gradually leaving a good surface for repainting.

Loss of Gloss.—The gloss on exterior paints is the result of using linseed oil, of having an excess of oil on the surface over what is needed to bind the paint. In the best of work the gloss is a very temporary finish and it has no doubt been overemphasized as to its importance. Boiled linseed oil will give a higher gloss than raw oil,

but it too will not last more than days or weeks at best.

When too little linseed oil has been used in the last coat of paint there will be little or no gloss. When too few coats of paint have been used on a dry and porous surface the paint will be dead flat in spots and only fairly glossy in others. When a job is finished late in the day and a frost or dew settles on the wet paint the gloss will often disappear, though no harm has usually been done to the wearing ability of the paint.

Thinking of the chemistry of the problem the loss of gloss means the beginning of the destruction of the oil in the paint. Oil is destroyed by oxidation. When it begins to dry it begins to oxidize. It continues to take on oxygen until the complete destruction of the film. That is one reason for using only a minimum of japan drier with paint. Drier speeds the drying, or oxidizing process. Too much drier simply causes the paint to wear out too soon.

Washing of Paint.—Cases of washing, that is the removal of the paint pigment by rains upon the surface, are not at all common. The point to be noted in this defect is the accumulation of pigment at the bottom of walls on the water table and at the foot of porch columns.

The cause of washing is usually stated as the action of sulphur gas from soft coal burned in industrial districts, by railroads or other coal burning institutions. Oil refineries and many other kinds of industries throw off sulphur gases from their manufacturing processes.

Washing of paint results from the presence of water soluble compounds on the surface. These water solubles may result from the action of the gases of the air or from the chemical actions of the paint pigments and liquids with each other. Excessive chalking of the paint indicates a condition similar to washing in so far as the rain washes down the loose pigment on the surface.

Paint which washes is usually in good condition under

the surface and, of course, the washing does no harm until it proceeds to the point where the wood is left bare and unprotected.

As a rule washing doesn't occur until after the gloss of the paint has disappeared, so the methods suggested under the heading of chalking for retarding that defect and prolonging the gloss are also effective to overcome or retard washing. A surface from which the paint has washed is usually in good condition for repainting.

Another characteristic of surfaces from which the paint is washing is that of streaks of dirt and blotches and stains. These can usually be removed by washing the surface with clear water, especially soft water.

Washing is of course more likely to occur in the cities and in the industrial districts than in the country, because of the greater amount of soft coal smoke and sulphur gases in the former localities.

Tacky and Slow Drying Paint.—Most cases of tacky paint on exterior surfaces become dry eventually, but often only after they have become discolored with dust or insects. Occasionally a job will turn up which will not dry hard in months and the author has inspected jobs which did not dry in a year and a half.

The causes of slow drying are many. The first one to look for is the use of adulterated linseed oil, oil in which kerosene or other mineral oils have been mixed, oil containing fish oil, rosin oil, gloss oil or some non-drying oil. Japan drier which has been mixed with one of these non-drying oils causes the paint to act in the same manner if used in any appreciable quantities. Even pure linseed oil which has stood around in open cans for a long time and which has become fatty or rancid will cause tacky paint. The foots from pure linseed oil, the thick oil drawn from the bottom of a barrel of pure linseed oil which has been subjected to many fluctuations of temperature, will cause paint to remain soft and tacky.

The use of large amounts of tinting colors of a cheap grade and which are ground in mineral oil or fish oil or some other non-drying oil will cause tacky paint.

The use of raw linseed oil in large proportion on a wet surface, a hard sap-filled wood, and oily or greasy wood or a surface washed with sal soda, when the soda has not been completely removed by washing, will cause the paint to remain soft and tacky. Cold, wet weather and hot, wet weather both retard the drying of paint. The use of slow-drying tinting colors like lampblack, yellow ochre and chrome green without enough japan drier will result in slow drying paint and under some conditions tacky paint. The spreading of a coat of paint over previous coats before the under coats have become completely dry is not only apt to cause slow drying or tacky paint but checking and alligatoring of the paint later on.

The application of a full oil paint to a high gloss surface of paint enamel or varnish without first sandpapering down the surface may cause slow drying and tacky paint for a while.

As to the remedy for tacky paint which is now on the surface. A coat of turpentine with about one fourth drier brushed on to the paint will often cause the tacky surface to disappear. If that fails, the application of a thin coat of paint composed mostly of turpentine, drier and pigment may remedy the difficulty. Otherwise about the only recourse is to burn and scrape off the paint and replace it with properly mixed paint of good quality.

Runs, Sags and Wrinkles.—Slow drying is one of the causes when paint runs, sags and wrinkles. The application of full gloss paint on to gloss surfaces, instead of flat or semi-flat surfaces, is the most common cause and of course the remedy is to mix the undercoats to dry flat or semi-flat by using more turpentine and less oil in undercoats.

Paint which is put on too thick, that is, when too much paint is put on and it is not well brushed out, is apt to result in one of these defects. The use of raw linseed oil in paint during wet, cold seasons or hot, wet seasons, especially over gloss surfaces and with slow drying colors like lamp black, chrome green and yellow ochre is likely to cause paint to run, sag or wrinkle.

Any of the causes related above for tacky paint and slow drying is apt to cause runs, sags or wrinkles.

When paint shows a tendency to perform in this way it can often be made to brush or spray on properly by first wiping over the surface with a cloth wet with benzine or turpentine; this to remove the gloss or grease.

Sandpapering is effective, of course, in cutting the gloss on wood trim to be painted and washing interior walls with water in which a little sal soda has been put will usually overcome the gloss enough to allow the spread of the paint easily.

Creeping and Crawling Paint.—These difficulties with paint are caused by the same conditions as are assigned for tacky paint, slow drying, runs, sags and wrinkles. Slow drying, too much gloss on undercoats, wet weather, wet surfaces and cold temperatures are at the bottom of such troubles. The remedy is proper mixing of undercoats, sufficient and correct brushing or spraying of the paint, wiping with benzine rags or rubbing down gloss with sandpaper.

Flies, Gnats and Dust.—Note what was written about tacky paint, slow drying and also about discoloration of paint.

Streaking of New Paint Coats.—Sometimes on brushing out new coats of paint little dark streaks or clouds of color are noted on the surface. This is always due to insufficient mixing or improper mixing. The streaks are caused by little specks of tinting color paste which were not well mixed with the paint. Strain the paint

through a metal screen or cheese cloth and mix well to remove the color not broken up.

Fading Out of Color in Spots.—When too few coats of paint have been spread upon a dry and porous surface the oil is likely to sink into the very dry spots. Then the gloss will disappear from those spots and the color of the paint will also change. Gray paints are likely to show this blotched appearance more than others. Lamp black appears to fade or bleach out when the oil leaves the surface.

Yellowing of White Paint.—Considering first paint mixed for and exposed on exterior surfaces, the most prominent causes of yellowing is the presence of a heavy, non-volatile mineral oil. Even kerosene in quantity will turn white paint yellow. Linseed oil is yellow and when mixed with white paint there is first an impression of a yellowish cast, but that disappears after thorough mixing and spreading the paint on to the surface. But mineral oils turn yellow on being exposed to the air and consequently white paint containing mineral oil turns yellow, too. Mineral oil also tends to dissolve gums or pitch in some woods, bringing them to the surface and causing more discoloration of a yellowish or brownish nature.

Another cause of yellowing is the presence of alkaline substances. When linseed oil soap is made it is simply the result of the combination of linseed oil and an alkali. Such soap is dark yellow. So when there is present on a surface an alkali like soda ash, borax, silicate of soda etc., the oil will saponify and turn yellow. Then the paint will appear yellow, too.

Ammonia fumes from ice making plants or other sources have been known to turn white paint yellow, but there are few opportunities for sufficient fumes of this sort to act upon paint.

Storm sash and window screens which have been recently painted and almost immediately stored away in dark rooms will be found to have turned quite yellow.

The reason for this is plain. Sunlight is required to bleach out the linseed oil used in white paint. When these screens or sash are exposed to the sunlight a week or two, however, the paint will bleach out white.

The yellowing of white paint and white enamel on interiors is more often noticed. The use of linseed oil in interior white paint should be carefully proportioned. Use it sparingly in the undercoats on new plaster and wood and not at all for finishing coats. Use turpentine or flatting oil as a thinner. Use white enamel in the finishing coats to gain a gloss surface. White enamel and turpentine or any light colored varnish and turpentine will give your interior white paint coats all the gloss you want and a more washable surface.

Discoloration of Paints.—The discolorations due to yellowing and to mildew are discussed elsewhere in this chapter.

The most common discoloration of paints, perhaps, is the result of mixing the paint so that it dries too slowly, remains tacky so long that considerable dust, pollen from growing plants or multitudes of small flies, gnats or other insects accumulate on the surface and stick to the paint. The remedy for this defect is obvious. Mix the paint to dry reasonably fast and avoid the slow drying, tacky paint discussed early in this chapter.

The pollen from trees, flowers and grasses is a much more fruitful source of discoloration of fresh paint than might be thought. The pollen is very abundant at certain seasons; it is more or less sticky and while it is yellow or light color while alive, the decayed pollen is nearly black and will stick to old paint as well as to new. After a surface has been wet by rain the paint is somewhat softer and both pollen and dust from roads, roofs or nearby fields will stick to the paint and discolor it.

Probably the average painter leaves this proposition pretty much in the hands of fate. He can mix his paint to minimize the risk of discoloration by making his

finishing coat harder,—by using less oil, more turpentine so as to put more pigment on the surface closely packed. But here he is confronted with the loss of high gloss, which is of little or no consequence up to a certain point except as the customer may think it important,—and he is also tempted to make his paint too hard by the mixture of pigments and so risk cracking and scaling of the paint. This, like most other problems in this business, is one where good judgment must be shown to establish a nice balance in the mixing and composition of the paint and its application.

The use of raw linseed oil without japan drier or the use of oil which has been adulterated to the point where slow drying occurs is the usual cause of paint discoloration by dust, smoke etc. Your paint should be mixed to dry dust free in not more than twelve hours.

An accumulation of rust from metal roofs, rain gutters etc, and accumulations of dust and soot have been known to wash down and discolor not alone fresh paint but old paint.

In some instances severe electrical storms will turn white paint gray in spots or in large areas, but the cause has apparently not been learned.

Discoloration by Sulphur Gas.—White paint and light tints are sometimes turned gray or darker by contact with sulphur gas. Industrial districts, where much soft coal is burned, throw off quite a volume of sulphur gas. Oil refineries and many other industries generate this gas. Coke ovens, steel and iron furnaces liberate this gas.

Sulphuretted hydrogen gas which is given off by stagnant water of swamps, sewage and manure heaps or similar decaying matter will discolor white paints and light tints made from lead compounds. White lead, carbonate, is changed by sulphuretted hydrogen gas to lead sulphide which is black. This gas has the odor characteristic of rotten eggs. This discoloration is not

at all of common occurrence and usually it is not permanent.

Discoloration from Copper.—The increasing use of copper wire fly screens and of copper for roof decks, rain gutters and down spouts is presenting a problem for painters the solution of which apparently has not yet been arrived at.

The corrosion of copper forms a greenish black incrustation on the surface which washes down during rains over white and light colored paint under windows and elsewhere. This dark stain penetrates the paint and it is quite impossible to remove it. The only remedy appears to be to paint over the stained areas and then coat the gutters, etc., with paint. The fly screens can of course be painted or coated with spar varnish to prevent this defect. There appears to be no other way, since the action of the weather on the copper is a continual process. As fast as the rain washes off the accumulation another forms and so the paint is stained anew several times each season.

Discoloration from Mildew.—Some discolorations thought to be mildew are accumulations of pollen from plants and trees. Inspection with a microscope to note the plant formation is the best test. Mildew is a fungus or vegetable growth. A wet cloth rubbed over mildew will usually show a green stain on the cloth.

Mildew develops most readily in hot, humid climates and in hot weather. The spores are sometimes found in new wood and sometimes the growth starts on top of the paint, penetrating through many coats and forming a black or dark discoloration. Soft, elastic paint rich in oil offers a more favorable condition than hard paint surfaces. And, of course, slow drying or tacky paint offers ideal reception to the development of mildew. Painting done in hot, humid weather is most likely to acquire this defect. Once mildew appears on a surface it is not easy to eliminate it, but it can be done.

As to the remedy for mildew and its prevention several points are of interest. On surfaces where mildew has appeared the first step is to scrub the dark spots with warm water and strong soap, laundry soap, using steel wool. Then thoroughly wash off with clear water and let the surface dry. When dry sandpaper these spots and coat with turpentine or a very weak solution of mercurous chloride and water.

Surfaces which have been treated as above should be painted with paint having little oil in it. The first coat may be mixed with about half-class linseed oil made from North American seed, not LaPlata oil, and half turpentine. Allow plenty of time for each coat to dry before putting on another coat. On new, porous, soft wood it is wise in some cases to increase the amount of oil a little and decrease the turpentine for the first coat. The object is to make a hard paint film which offers a minimum opportunity for the mildew spores to develop. So the second coat on old work may be mixed with only about 3½ gallons of raw linseed oil and 1½ pints of turpentine to 100 lbs. of lead when lead is being used. When prepared paint is used pour off the oil on the top and replace about one forth of it with turpentine. When raw oil is used about 1 pint of good drier is needed for the 100 lb. lead mixture.

When mildew has penetrated several coats of paint and is lodged in the wood the washing with soap and water may not do any good. It is necessary in such cases to treat the mildew spots with a germicide to kill the growth or it will continue and come to the surface through many coats of paint. A wash of a weak solution of corrosive sublimate (bichloride of mercury, or mercurous chloride) should be brushed on with an old calcimine brush. One ounce of corrosive sublimate to three gallons of water is about the correct strength for this germicide. When this wash is dry apply the paint, but not before. A small percentage of this germicide in

the paint will be beneficial. When the corrosive sublimate is to be added to the paint dissolve one ounce of the chemical in a very little denatured alcohol and mix it into each gallon of paint for the first coat and the second coat. Mix this chemical well into the paint and also stir the paint occasionally while in use to keep the mixture right, otherwise the chemical will settle to the bottom of the pot. Remember that corrosive sublimate is a deady poison. Handle it with care. Keep it out of cuts in your skin and out of the way of children.

In addition to reducing the oil content of paint to a safe minimum on surfaces which are subject to mildew some painters like to add a little zinc oxide to white lead mixed for the last coat only to make a little harder wearing surface. About 15 per cent or 20 per cent of zinc will serve this purpose.

Spotting of Paints.—The usual spotting noted is in the form of lighter spots on light tinted paints. These occur most often around putty, nail heads and along cracks. This kind of spotting appears more often in two coat work than in three coat jobs. It is the result of putting on to the wood too little oil or not enough coats of paint to satisfy suction of the wood in very dry, porous places. When the oil sinks into the porous places the pigment appears lighter in color but when more oil is added to those spots the color often returns to the original hue. The remedy is that of allowing plenty of time for each coat to dry so that this spotting will show up before the final coat is put on and so the spots can be touched up with more paint or oil before finishing the job. Gray paints and blue paints are especially likely to develop this spotting defect. The gray appears to bleach out in spots and sometimes in large patches.

A different kind of spotting sometimes results when an upper story of a house is finished with plaster stucco.

Little splashes of lime drop on to the unfinished wood below. If not completely removed this hot lime burns the life out of the oil in the paint and causes the color to bleach out.

CHAPTER XVIII

THE PAINT SHOP

Appreciation of the important part which the paint shop plays toward the realization of profits in a painting business is growing greater year by year. As contracting painters see more of modern factory planning, organization and equipment they realize the necessity for applying the same principles of organization and management to their own businesses. And that is very encouraging to all concerned, because it is doubtful if any other business can be found which requires in its every day conduct of business so many materials, so many tools of varying kinds and such a quantity of other equipment all at the same time. This great variety of materials, tools and equipment properties makes the opportunities for loss by poor management greater and also the benefits from good management the more attractive.

The question before us, then, is—what is a good shop? It has always been necessary in the painting business to keep expenses down and it always will be necessary. The same is true in all business undertakings. The most successful merchants do not have fine stores because they can afford them, but because it pays to have them, it is good business. If a painter waits until he has accumulated enough money to have a fine shop to support just as a luxury that is poor business. And for that reason he probably would not support a fine shop as a luxury because by the time he learns how to make enough money to do that he is too good a business man

to support anything which doesn't pay as a business proposition.

The right kind of a shop will pay its way and bring in more business. By the right kind of shop is meant one which is well located for business reasons, one which is adequately heated, lighted, decorated and arranged in a way which will make customers and employes alike feel that here is a business which is sound and knows what it is about;—that is confidence and more business can be built upon confidence than upon cold cash in the bank.

Shop Locations.—Several considerations enter into the selection of a shop to be rented or to be built. A central location, one where the shop will be quite as near one part of the section to be drawn upon for trade as another, has always been considered of first importance. It is important but not so important as at one time. The use of automobiles and trucks has made it possible to select better locations which are sometimes not central.

The placing of a painter's shop on the main business street or in a good location down town where many people pass by and see it has been considered unimportant. As a matter of fact it is of great importance.

So a shop in a good location where many people may see it along with other businesses of the community will pay well by keeping the painter's name before the prospective customers, by making it easy for the customers to drop in and talk about their needs in the line of painting and decorating, by making it possible to display samples of decorating and painting jobs done in attractive shop windows not only to indicate the skill of the painter but also to suggest jobs which others may want done.

The other factors involved in the selection of a location are rents, prices of land, taxes, insurance, trans-

portation conveniences for the journeymen and a few others of less importance.

Plans and Arrangements.—Many satisfactory plans and arrangements of the essentials of a good shop may be made, depending upon the size and shape of the shop at hand. Plate 141 offers some suggestions which may be of benefit in this direction.

Lighting Essentials.—Few factors are of greater importance in a paint shop where good work is to be done than light. And daylight is far better than any artificial light, so the paint shop should come as near in design to a greenhouse as is practical. At least large windows and many of them are highly desirable. Then in addition electric lights of ample size and well distributed with extension cords are likewise important for dark days. Surprisingly poor painting and decorating can be done with poor light and without the knowledge or intention of even good workmen. Then the matter of colors always enters. Good judgment of colors cannot be had unless the light is good, and natural light is necessary unless the special electric light bulbs made for color correction are used.

The Paint Shop Office.—Most craftsman dislike office work, but that doesn't help the business any and usually is a great detriment to it. A light, clean and warm shop is essential, and doubly so when women are about for helping with this part of the business. Another point, customers are apt to call and a businesslike office is one of the strongest factors toward building up confidence in the shop and the service it sells.

The Material and Tool Stock Room.—It would be difficult to find a business which loses more money in tools and materials which are wasted by carelessness and lost by theft. Most factories large and small have encountered the same problem and the universal practice is that of establishing a stock room in charge of one man who is held responsible for materials and tools re-

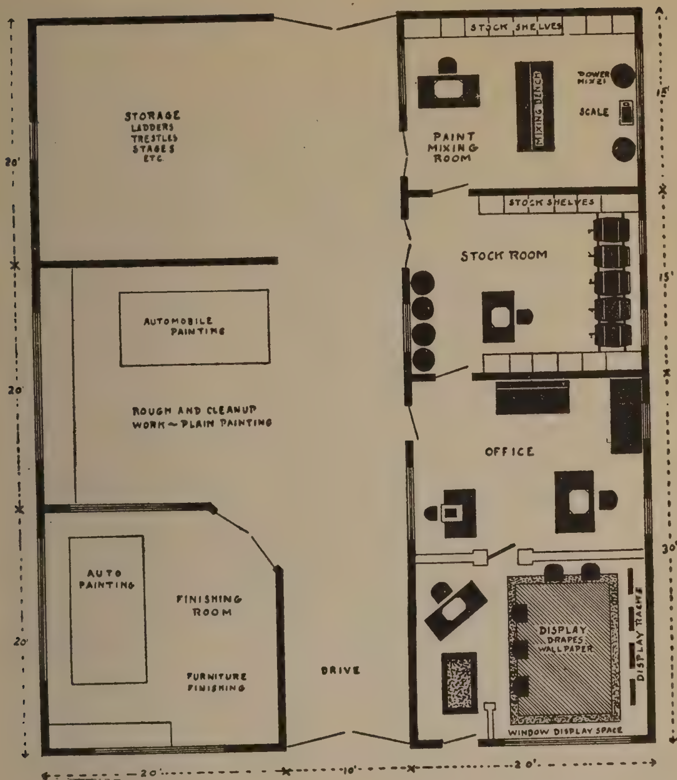

Plate 141.—A better Paint Shop Plan. For efficient operation and all year round work

ceived and what is issued for each job on requisitions signed by some one in authority. With such an arrangement the materials and tools received can be checked up, materials sent to jobs will be known and materials returned and used on jobs will be known.

Paint Mixing Facilities.—A great deal of time is lost in most shops by not having reasonable facilities for

mixing materials. In some shops not even a bench is available and the idea of mixing by machine power seems quite novel to many. No shop which even pretends to handle expensive labor with methods which assure a fair day's work for fair pay should be without a mixing bench of good size which is covered with sheet iron and which has shelves on it to conveniently carry all colors, liquids and tools needed in mixing materials.

Large batches of materials can be much more profitably mixed with power mixers and much better paints are so mixed than can be done by hand. Plate 98, Chapter V, pictures such mixers. At least one of these machines should be in service near every mixing bench.

Storage tanks for oils, turpentine, benzine, varnishes, etc., located in the basement with hand pumps near the mixing bench constitute an important and safe equipment in any shop. Where barrels are used racks and proper provision for measuring and weighing should be at hand. Also spigots of a non-leaking type should be used and locks provided for each barrel.

About the Shop Man.—The opportunity for keeping a dirty and disorderly shop is far greater in the painting business than in others, especially when labor costs are high as compared to material costs, but the urgency of orderly conduct of business and arrangement of shops is also greater, due to fire risks and the loss of materials and tools. It is doubtful if any shop can be properly kept in order without at least one man of a neat and orderly disposition and above all an honest man to take care of this end of the business.

The Finishing Room.—A paint shop which is going to do high class finishing of furniture, automobiles and any other jobs of that character must be clean throughout and must be arranged in such a way as will permit keeping the place clean without too much work.

Having one room set apart for doing mussy, dirty jobs is one way to help keep the main shop clean. Such

a place is essential for the cleaning of automobiles, scraping and sanding of furniture, removing paint and varnish, etc.

Then a room for doing finishing with fine color coats and varnishes is likewise essential. In such a room arrangement should be made to keep it free from dust, for increasing or decreasing the ventilation and for maintaining temperature up to 100 degrees or more when necessary. Absolute control of dust, air and heat, as well as moisture, is essential for best results.

CHAPTER XIX

OXIDIZING COPPER SURFACES

The use of copper for store and shop fronts, for canopies out over doors and sidewalks at hotel and theatre entrances, for cornices, rain gutters, down spouts, roof decks and elsewhere is becoming quite extensive. And in consequence painters are called upon at times to hasten the natural oxidizing of the copper to gain a mottled bright green color. This is the appearance given to copper by long exposure and is called patina. It is sometimes mistakenly called verdigris.

Verdigris Green Finishes.—Real patina is an incrustation, a corrosion of the copper metal resulting from gases or other atmospheric conditions. Verdigris green finishes are paint coatings.

Verdigris finishes are put on to wood, iron and other surfaces by first painting them with a copper color to dry without gloss. Then the tinting color known as verdigris green, ground in oil, is used as a glazing color over the flat copper colored surface. A glazing liquid composed of about half boiled linseed oil, one fourth turpentine and one fourth benzine is mixed up and a thin coat is brushed on to the copper ground color. Then a little of the glazing liquid is mixed with the verdigris green paste and daubs of the green are put on here and there while the glazing liquid is wet. Then a wad of cheese cloth is used to stipple the surface and to motle and blend the color out into an imitation of the natural patina. For exterior exposure a coat of spar varnish should be put on to protect the surface from the

weather. A stippling brush may be used to do the blending instead of the cheese cloth.

Natural Copper Patina.—Real patina, *serugo nobilis,* on copper is called antique bronze by some and is simply basic carbonate of copper or hydroxide of copper, a chemical change in the copper metal produced by atmospheric and earth conditions. A long time is required to make the change on the surface of the metal by natural incrustation. It takes too long, so painters hasten the process in this manner.

Scrub the surface clean with warm water in which a little sal soda, washing soda, has been dissolved. Use fine steel wool for the scrubbing. Next wash off the copper with clear water and wipe dry.

Several acid and alkaline solutions with water can be used for producing the natural patina, but some are better than others. Acid solutions work more slowly than alkaline. The acids dissolved in water and used for this work are acetic, oxalic and muriatic. The alkalines dissolved in water and used in solutions are sal ammoniac and carbonate of ammonia.

Here are some of the formulas used for producing natural patina without waiting for the slow natural action of the atmosphere and age. One of the most durable of finishes of this kind on copper is produced by this solution. Four or five days are required for the final color to appear, although some change is noticeable at once:

1 ounce sal ammoniac
3 ounces tartaric acid
9 ounces common salt
15 ounces boiling water

Dissolve the above in the boiling water and then add

8 ounces of a solution of nitrate of copper of a specific gravity of 1.100

Brush this mixture on to the clean copper, let it dry

a few minutes and repeat the wash several times. This formula acts with greater speed when the air is moist than when dry. A rainy day is a good time to do the job. More salt in the solution makes the finish more greenish in tone, while less salt gives a bluish color.

Another formula which is sometimes used follows. It is even slower to gain the final color than the first formula mentioned:

1 ounce acetic acid, 1.04 specific gravity
50 ounces water

Sponge the surface several times each day with this solution after cleaning it to as bright a finish as possible. In two or three days a coating of acetate of copper will appear. Then in contact with the carbonic acid in the air this incrustation will form carbonate of copper which is very similar to natural patina. It will take a week or two before the final color appears on the copper, although some color will appear almost at once.

A third solution used for oxidizing copper is mixed this way:

5 ounces sal ammoniac
5 ounces tartaric acid
22 ounces common salt
40 ounces copper nitrate solution in water, specific gravity 1.100
30 ounces common vinegar
3 ounces water

A fourth solution used for quick results is mixed in this way:

4 ounces verdigris green
2 ounces sal ammoniac
1 quart acetic acid, 15% strength

Brush on and repeat if necessary to get color wanted. Wash off, let dry and brush on a coat of thin spar varnish.

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